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GOAT GRAZING IN KASHMIR.

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Few parts of India have suffered more severely from the inroads of foreign goats than the Jammu and Kashmir State and probably few administrations have been able to tackle the problem so successfully as His Highness' Government. But a definite policy with regard to goat grazing was not evolved in a day and it was actually twenty years from the time attention was first drawn to the depredations of these foreign shepherds until the present policy was worked out and laid down, and during that time a great deal of the damage done by them was irrepairable.

Less than seventy years ago, in fact within the memory of living man, the lower hills of the Jammu province were densely wooded and much of this part of the country is shown on the earlier survey sheets as forest. Now little of this forest remains. Natural vegetation, with the exception of useless shrubs, such as *bahekar* (*Adhatoda vasica*), which goats do not eat, has been destroyed; the country has been cut up with innumerable ravines, which year by year, become larger and larger; while with the progress of denudation, springs have dried up and cultivated lands have been destroyed. In fact, in many places the people now find difficulty in obtaining a livelihood for themselves or grazing for their half starved cattle.

Such is the condition of the lower hills of Jammu, an object lesson to those who see in the goat an asset of economic value. Had not the problem been tackled when it was and steps been taken to reduce these nomadic herds to reasonable limits, there is little doubt that their destructive work would have eventually reduced the whole country to a state of barrenness, comparable to Southern Europe, wherein even goats would have found it difficult to exist in large numbers.

The cause of these foreign graziers first migrating to Kashmir is unknown. The *Bakkarwals*, a generic name for Hazara and Trans-Frontier goatherds, appear to have started coming to the State about fifty years ago, and one theory is that they were driven out from the Kagan Valley by the introduction of forest reservation. This, however, is improbable. More likely, a few adventurous Kaghani shepherds, looking for new pastures on which to support their increasing herds, strayed across the border to the Kishenganga Valley and from there found their way down to the Jammu hills for winter grazing. Once there it would be easy for them to migrate with the Jammu shepherds to Kashmir for the summer and, as at that time the Kashmiri villager kept no goats and comparatively few sheep, these alpine pastures must then have been even more wonderful grazing grounds than they are at present. Their fame would soon be carried back to Hazara, attracting more and more flocks from year to year.

This, of course, is largely surmise, but one thing is certain, that by 1893 the number of these foreign goats was considerable, for Sir Walter Lawrence, in his "Valley of Kashmir," refers to the enormous flocks that were yearly brought to Kashmir from the lower hills of Jammu, and while admitting that they brought in revenue, he regretted the wanton destruction done to the forests by the graziers. At that time the *Bakkarwals* were welcome intruders and were even encouraged by the State to come in, in order to enhance the grazing tax. Little heed was paid to forest damage, and it was not until 1904 in the Assessment Report of the Bhimber Tehsil that attention was drawn by the Settlement Officer to the fact that the grazing in the lower hills was

rapidly deteriorating and the local zamindars were being unduly troubled by the annual incursion of these vast hordes of foreign goats.

A proposal to reduce the incidence of grazing, by doubling the tax on foreign goats found, however, little favour with the Revenue Department, the Governor of Jammu taking the line that as the low hill forests were valueless as timber producers, it was better for the State to obtain what revenue it could from them, by allowing them to be eaten by goats, and for this reason he opposed increased taxation as being likely to drive from the State a very valuable source of income.

It was at this stage that the Forest Department was first consulted, and here it is necessary to digress briefly to explain the peculiar conditions under which grazing in the State is administered. The grazing tax is an old institution, dating back probably to the first Maharaja, Gulab Singh. In its earliest days it was collected in kind, but later on the tax was farmed, the farmer or contractor paying a fixed sum to the State. This system was subsequently abolished and a *Kahcharai* Department was established to recover the tax, after enumeration, according to a sanctioned scale of fees. The Forest Department, as an organised department, came into existence in 1890, when McDonell, a lent officer from India, joined the State as its first Conservator of Forests.

The control of grazing being an important factor in forest management, it would have been only reasonable for the Forest Department, when organised, to have taken over the whole of the grazing administration and control, but although this was mooted on several occasions it was always opposed and to this day the *Kahcharai* Department survives as a separate branch of the Revenue Department. Naturally the interests of the two departments are always at variance, for while the *Kahcharai* Department, being purely revenue producing, welcomes any increase in the number of animals, the Forest Department's one hope of saving its forests lies in keeping the grazing incidence within reasonable limits.

It was perhaps this divergence of interests, coupled with the fact that the Forest Department had no control over grazing, that was the chief hindrance to the evolution of a definite goat grazing policy. Nevertheless for twenty years successive Conservators carried on their up-hill struggle and it was entirely their guiding influence which steered the State to its present policy, the expressed intention of which is to tax the migratory goat out of existence.

The successive stages by which this policy was arrived at are not without interest. When first consulted in 1904, the Conservator, Blunt, was able to give first hand information regarding the enormous damage that was caused to the forests by unrestricted goat grazing, not only in the lower hills of Jammu, but also, and even more so, in the high level birch forests of Kashmir. The damage, he pointed out, was not only from grazing but also from lopping, and he suggested the raising of fees on foreign cattle and herds to a point which would bring their numbers to reasonable limits. This proposal was not accepted, but two years later His Highness sanctioned, as a trial measure, the doubling of the existing tax, Rs. 9-6-0 per hundred, on Kaghani goats. At the same time he suggested that, as the *Bakkarwal* flocks were not the only animals that damaged the forests, proposals should be made for closing certain valuable forests and for prescribing the routes by which nomadic flocks should pass through the forests on their way to the upper grazing grounds. This order was the genesis of the present forest closure rules and the rule prohibiting the grazing of nomadic flocks in any deodar forests, except within three hundred yards of a recognised main route.

In 1908, Lovegrove, who was then Conservator, again raised the question and suggested that the time had come when grazing taxation should be levied on a more scientific basis. He proposed a scale of "ordinary" rates for the cultivators' necessary live-stock, and to determine what could be considered necessary he took three *ghumaons* of cultivation as the unit of area, and allowed for every unit or fraction thereof, grazing at "ordinary"

rates for what may be termed 30 live-stock units, worked out according to the following scale :—sheep or goat, one unit ; cow or bullock, three units ; buffaloe, six units. This scale was liberal and few ordinary cultivators could have been affected by the higher rates for "excess" cattle, which it was proposed should be 50 per cent. more than the "ordinary" rates. For "outsiders," owning no cultivation in the State, four times the "ordinary" rates were suggested for goats, and three times for other animals.

These proposals were never sanctioned, but they started a new train of thought, and after a voluminous correspondence, lasting for seven years, in which the question was discussed from all possible and impossible points of view, new rules were issued in 1915, which divided taxable people into three classes :—

(*a*) permanent residents of a village who do not migrate with their live-stock for summer grazing ;

(*b*) people who migrate with their live-stock from place to place within the State, and

(*c*) people who come from outside the State for the purpose of grazing.

Class (*a*) were charged at ordinary rates ; class (*b*) at double rates ; and class (*c*) at eight times the ordinary rates.

These rules were a definite step forward, as they made, for the first time, a clear distinction between the three classes of animals, but the hope that the eight times rate would reduce the number of the *Bakkarwal* herds proved fruitless as by this time practically all the *Bakkarwals* and Khaganis had become permanent residents in the State and so came under class (*b*), while comparatively few foreign goats were then coming to the State. The new rules, therefore, had little or no effect on the number of goats that browsed in the State.

Something more was needed, and in the following year the Conservator, Coventry, in a very able note again emphasised the enormous damage that was done by goats, and requested Government to lay down a definite policy with regard to goat

browsing. As a suggestion he put forward the total exclusion of foreign goats and an increasing scale of taxation so as eventually to exterminate all nomadic flocks. Further lengthly discussions ensued, but by 1919 opinion had crystallised, a definite policy was evolved, and new rules were drafted, the objects of which were the exclusion of foreign goats from the whole State, the exclusion of all goats from the Kashmir Valley, and the gradual extermination of migratory flocks by means of increasing taxation. To secure these results the following rates of taxation were proposed :—

(*a*) for permanent residents of the Kashmir Valley, on all goats,

during the first year 3 annas per head,
during the third year 6 annas per head,
during the fifth year 10 annas per head,

and thereafter increasing by 4 annas every other year;

(*b*) for migratory flocks,

during the first year 6 annas per head,
during the second year 9 annas per head,

and thereafter increasing by 3 annas every year;

(*c*) foreign goats were prohibited from entering the State altogether.

These rates were brought into force for Kashmir and for Jammu goats coming into Kashmir in 1920, and in 1926 the rates for migratory goats within the Jammu province were raised to the same level as those in Kashmir. The rates now being charged are Re. 1-8-0 per head for goats belonging to residents in the valley, and Rs. 2-5-6 on all migratory flocks.

In the case of the latter the rate is rapidly reaching the limit at which it will no longer be profitable to keep large flocks of goats. Already there has been a very large falling off in numbers, and provided the present policy is persisted in, the term *Bakkarwal* will soon be a misnomer, for the whole of his flocks will be sheep, and the Kashmir forests will be spared from the voracious appetite of the migratory goat.

Ganga Singh, Del.

Klemachloa detinens R. N. Parker.

A BURMESE CLIMBING BAMBOO.

Klemachloa R. N. Parker gen. nov.

BY R. N. PARKER, I.F.S., FOREST BOTANIST.

Spiculæ 1-2-floræ, floribus hermaphroditis. Glumæ membranaceæ, vel papyraceæ, multinerves, ab imo gradatim paulo auctæ, 2 inferiores vacuæ; florens vacuis similis, palea floris superioris spicularum biflorarum vel floris unici spicularum uniflorarum ecarinata. Lodiculæ 3 vel 2. Stamina 6, filamenta libra. Ovarium apice pubescens, stylus longus, integer, stigma plumosum. Caryopsis oblonga apice rostrata, hilo basilari punctiformi.

Gramen arborescens, scandens. Spiculæ secos ramos elongatos dissite glomeratæ; rachilla ultra flores non producta. Species unica.

Klemachloa detinens R. N. Parker sp. nova. Alte scandens, culmis 20-30 mm. diam. internodiis circiter 60 cm. longis glabris nitidis, juventute pulvere albo flocculoso obtectis, pseudophyllis tenuis mox deciduis circiter 15 cm. longis. Folia 20-30 cm. longa, 4-6 cm. lata, oblongo-lanceolata, basi cuneato-rotundata, apice acuminata, marginis scabris, subtus glauca et paullo asperula, supra laevia, nervis secundariis utrinque 9-10, intermediis 7-8; vaginæ glabræ, striatæ; ligula 3-5 mm. longa, erecta, truncata glabra. Paniculæ ex ramulis foliatis ortæ, pleurumque terminales, eramosæ; rhachis pulverulenta. Spiculæ 7-8 mm. longæ, glommerulatim congestæ, glomerulis dissitis paucispiculis. Glumæ vacuæ 4-6 mm. longæ, papyraceæ, irregulariter 9-15-nerves; gluma florens quam vacuas, acutior, tenuior et circiter 1 mm. longior; palea 7 mm. longa, oblonga, subhyalina, subacuta, 2-nervis, nonunquam 5-8-nervis quarum 2 validioribus, dorso minutissime puberula. Lodiculæ 2-3, apice ciliatæ. Filamenta glabra, antheræ 4 mm. longæ, basi sagittatæ, apice acutæ. Caryopsis rostrum inclusum 6 mm. longa, 2 mm. diam. oblonga, embryo vix 1 mm. longus.

Burma, Mergui district on Myinmolekat 600-1200 m. elevation Parker No. 3130, 3132.

This bamboo flowered gregariously in patches in 1929 and it was with difficulty that flowering specimens could be found in 1930. The stems climb to a height of 60ft. and have remarkably large buds at some of the nodes. The culm-sheath unfortunately could not be obtained, they fall off early and rot rapidly on the ground.

As regards the systematic position of this bamboo it is one of the *Eubambuseæ*. From *Bambusa* it differs in the spikelets being usually 1-flowered and in the palea of the flower (or of the upper flower if the spikelets are 2-flowered) being not keeled. Normally in *Bambusa* the spikelet starts with several empty often gemmiparous glumes followed by several flowering glumes separated from one another by a distinct elongation of the rachilla and ends with a tabescent tip. In *Klemachloa* the spikelet consists of 2 empty glumes followed by 1 or occasionally 2 flowering glumes, the rachilla is not prolonged beyond the flowering glumes.

From *Nastus* it differs in having 1-2 fertile flowers, in the acute anthers and un-divided style. It is perhaps nearest to *Oreobambos* from which it differs in having usually 1-flowered spikelets and conspicuous lodicules. *Oreobambos* is an erect bamboo whereas this is a climber.

In *Klemachloa* the spikelets occasionally show the lower flower very greatly reduced but more often in the one-flowered spikelets it seems to be the upper flower including its glume which is missing. The spikelets are suggestive of the *Panicoideæ* rather than the *Pooideæ* except when they produce 2 fruits. In collecting "seed" off the ground what is collected consists of the caryopsis wrapped in the palea and flowering glume with 2 or 3 additional glumes outside. This means that the fruiting spikelet has fallen entire as it does in the *Panicoideæ*. A very small proportion of the "seed" however shows the caryopsis enclosed in the flowering glume and palea which are attached to a very short joint of the rachilla. Such "seeds" have come from the lower flower of 2-flowered spikelets and they closely resemble the "seeds" of *Bambusa*. The caryopsis is very similar

to that of *Bambusa* but the longitudinal groove is much shallower.

The spikelets are supported at the base by bracts differing from the glumes in having a rather prominent scabrid keel. The glumes are much thinner than in *Bambusa* and when fresh are tinged with pink on the edges. The lodicules are conspicuous and very like those of *Bambusa*. Two are usually somewhat longer and more elliptic than the third though sometimes all three are similar. I have more often found 2 than 3 lodicules present and the two may be similar or one is shorter and subquadrate.

The name is taken from *Klema* the Greek form of *Clema*, a plant mentioned by Pliny and *chlœ*, grass. *Clema* has been variously interpreted as a Polygonum, Equisetum or Ephedra, all plants with jointed or noded stems.

This species is very like *Bambusa klossii* Ridley a species the flowers of which I have not examined as Ridley states the uppermost flower is too young to make out. Under the circumstances, therefore, it is not necessarily placed in the correct genus and must be added to the many bamboos described on quite inadequate material. *B. klossii* differs from *K. detinens* in vegetative characters.

Plate 1.—Fig 1. Flowering branch, 2. Ligule, 3. Spikelet, 4. Flowering glume, 5. Palea, 6. Stamen, 7. Ovary, 8. Lodicule, 9. Caryopsis with 2 lodicules still persisting.

DURABILITY TESTS ON UNTREATED INDIAN TIMBERS.

BY F. J. POPHAM, F.I.C., OFFICER-IN-CHARGE, WOOD PRESERVATION SECTION, FOREST RESEARCH INSTITUTE.

The durability tests on Indian timbers at the Forest Research Institute at Dehra Dun have now been completed for 79 species. Tests on other species are proceeding. It is realised that these tests are empirical and subject to variation in different localities. The actual period of durability will naturally vary with external conditions, but an approximate comparison is perhaps possible.

The method adopted for the test is to place 6 stakes 2′ × 2″ × 2″ in ground invested with termites, the particular species in the Dehra Dun test yard having been identified as *Odontotermes bangalorensis* Holmgren.

Some doubt arises as to the proper method of recording the results. Some species, notably the less durable, are attacked simultaneously in all of the 6 sticks and the period of durability is readily ascertained. Others show wide discrepancies, there being as much as 2 to 3 years' difference between the first and last rejection. The tentative figure adopted is the period when 3 or more of the test sticks are rejected. This figure is generally nearer to the period of the first rejection than the last.

The tables have been divided into groups representing 6 months periods, and the actual durability period has been marked against each species, so that it can be readily seen which species tends to pass from one group to another. Tables of unfinished tests have also been added.

Group 1.—0-12 months.

Sterculia campanulata	...	4	
Acer campbellii	...	6	
Fraxinus floribunda	...	6	
Canarium euphyllum	...	7	
Myristica attenuata	...	7	
Parrotia jacquemontiana	...	7	
Crataeva religiosa	...	9	
Cryptocarya amygdalina	...	9	
Bombax malabaricum	...	12	Figure probably high.
Crypteronia japonica	...	12	

Group 2.—13-18 months.

Boswellia serrata	...	13	
Garuga pinnata	...	13	
Lannea grandis	...	13	Formerly *Odina wodier*.
Bombax insigne	...	14	
Anthocephalus cadamba	...	14	
Cullenia excelsa	...	14	

Terminalia chebula ...	14	
Picea morinda ...	14	
Parishia insignis ...	14	
Polyalthia fragrans ...	15	
Swintonia floribunda ...	18	

Group 3.—19-24 months.

Diospyros pyrrhocarpa ...	19	
Diospyros melanoxylon ...	19	
Alstonia scholaris ...	19	
Dillenia pentagyna ...	20	
Dipterocarpus griffithii ...	20	
Duabanga sonneratioides ...	21	
Bauhinia retusa ...	22	
Sonneratia apetala ...	22	
Eugenia praecox ...	23	
Michelia cathcartii ...	23	
Mangifera indica ..	23	
Terminalia pyriofolia ...	23	
Machilus gamblei ...	23	
Planchonia andamanica ...	23	
Stereospermum chelonoides	23	
Albizzia lucida ...	23	
Juglans regia ...	24	
Mitragyna diversifolia ...	24	Formerly *Stephegyne diversifolia.*

Group 4.—25-30 months.

Casuarina equisetifolia ..	26
Hymenodictyon excelsum...	28
Adina cordifolia ...	28
Vateria indica ...	28
Holoptelia integrifolia ...	28
Aegle marmelos ...	28
Quercus lamellosa ...	28
Dipterocarpus turbinatus...	29
Dillenia indica ...	29
Lagerstroemia tomentosa...	29

Group 5.—31-36 months.

Anogeissus latifolia ...	31	
Bischofia javanica ...	31	
Cinnamomum cecicodaphne	31	
Cedrela toona ...	31	
Pinus longifolia ...	31	
Adina cordifolia ...	32	Kiln seasoned.
,, ,, ...	32	Air seasoned.
Terminlia belerica ...	32	
Mitragyna parviflora ...	32	Formerly *Stephegyne parviflora.*
Abies pindrow ...	33	Figure probably high.
Crypteronia paniculata ...	33	
Dipterocarpus macrocarpus	34	Formerly *D. pilosus.*
Chloroxylon swietenia ...	34	
Machilus spp. ...	35	
Dipterocarpus kerri ...	35	

Group 6.—37-42 months.

Castonopsis hystrix ...	38	
Terminalia chebula ...	38	
Dipterocarpus tuberculatus	38	
Terminalia procera ...	39	
„ *bialata* ...	42	

Group 7.—43-48 months.

Shorea assamica ...	44	
Albizzia stipulata ...	44	
Acrocarpus fraxinifolius ...	44	
Dipterocarpus obtusifolius	45	

Group 8.—49-54 months.

Eugenia gardneri ...	50	Fungus attack only.
Lagerstroemia parviflora	52	Do.
Terminalia manii ...	54	

Group 9.—55-60 months.

None.

Group 10.—61-66 months.

Terminalia paniculata ...	61	
Shorea talura ...	62	
Bursera serrata ...	66	Fungus attack only.

In view of the possible confusion with the *Dipterocarpus* spp. these are given below for comparative purposes :—

Dipterocarpus griffithii ...	20	
,, *turbinatus* ...	29	
,, *macrocarpus* ...	34	Formerly misnamed *D. pilosus*.
,, *kerrii* ...	35	
,, *tuberculatus* ...	38	
,, *obtusifolius* ...	45	

TABLE 2 (*a*)

DURABILITY TESTS ON UNTREATED INDIAN TIMBERS.

Uncompleted tests arranged in order of time; some class A remaining.

A. Heartwood not attacked by white ants or fungus, or only slightly attacked by either or both of them.

B. Heartwood moderately or badly attacked.

RW. Number removed mainly owing to white ant attack.

RF. ,, ,, ,, ,, ,, fungus ,,

RW & F. ,, ,, ,, ,, ,, both white ant and fungus attack.

Serial number.	No. of specimen.	Species.	Period under test (in months).	A.	B.	R.	REMARKS.
8	43 to 48	*Terminalia tomentosa.*	66	1	2	2 F	One stick missing.
21	121 to 126	*Albizzia procera* ...	62	3	...	3 W & F	
26	151 to 156	*Dalbergia sissoo* ...	62	1	1	4 W & F	
27	157 to 162	*Lagerstroemia microcarpa.*	61	2	1	3 W & F	Kiln seasoned.

Serial number	No. of specimen.	Species.	Period under test (in months).	A	B.	R.	REMARKS.
28	163 to 168	*Lagerstroemia microcarpa.*	61	4	1	1 W & F	Air-seasoned.
30	175 to 180	*Terminalia arjuna..*	58	3	3	...	
32	187 to 192	*Ougeinia dalbergioides.*	58	4	2	...	
33	193 to 198	*Dalbergia sissoo* ...	58	3	3	...	
34	199 to 204	„ *latifolia* ...	58	6	...	...	
36	211 to 216	*Parashoera stellata...*	58	2	4	...	
40	235 to 240	*Pterocarpus dalbergioides.*	57	5	1	...	
46	271 to 276	*Artocarpus chaplasha*	53	3	...	3 F	
47	277 to 282	*Altingia excelsa* ...	53	3	1	2 W & F	
50	295 to 300	*Hardwickia binata*	53	5	1	...	
52	307 to 312	*Eugenia jambolana...*	53	2	1	3 F	
54	319 to 324	*Dipterocarpus indicus.*	53	2	3	1 W & F	
60	355 to 360	*Poeciloneuron indicum.*	52	1	2	3 W & F	
61	361 to 366	*Bursera serrata* ...	52	4	1	1 W & F	
64	379 to 384	*Schleichera trijuga*	52	1	1	4 F	
65	385 to 390	*Bassia latifolia* ...	52	4	...	2 W & F	
67	397 to 402	*Cedrela serrata* ...	51	2	3	1 W & F	
70	415 to 420	*Xylia dolabriformis*	50	2	2	2 W & F	
71	421 to 426	*Cedrus deodara* ...	50	3	3	...	
72	427 to 432	*Mesua ferrea* ...	50	6	...	...	
76	451 to 456	*Albizzia lebbek* ...	50	1	3	2 W & F	
81	481 to 486	*Tectona grandis* ...	49	4	1	1 F	
84	499 to 504	*Shorea robusta* ...	49	6	...	...	
85	505 to 510	*Pinus excelsa* ...	49	1	1	4 W & F	
89	529 to 534	*Calophyllum tomentosum.*	47	2	4	...	

Serial number.	Number of specimen.	Species.	Period under test (in months).	A.	B.	R.	REMARKS.
90	535 to 540	*Pterocarpus marsupium.*	46	3	3	...	
91	541 to 546	*Artocarpus hirsuta...*	46	1	...	5 F	
92	547 to 552	*Homalium tomentosum.*	46	1	3	2 W & F	
94	559 to 564	*Heterophragma adenophyllum.*	45	4	1	...	Fungus only.
96	571 to 576	*Mesua ferrea* ...	45	4	1	1 W & F	
97	577 to 582	*Phoebe hainesiana..*	44	4	2	...	
101	601 to 606	*Castanopsis tribuloides.*	44	6	...	...	
103	613 to 618	*Cleistanthus collinus*	44	3	...	3 W & F	
104	619 to 624	*Dalbergia oliveri* ...	44	6	...	...	
106	631 to 636	*Dysoxylum binectariferum.*	45	5	1	...	
107	637 to 642	*Eriolaena candollei...*	44	6	...	...	
108	643 to 648	*Gluta tavoyana* ...	44	6	...	...	
109	649 to 654	,, *travancorica...*	44	5	...	1 F	
110	655 to 660	*Hopea odorata* ...	44	1	4	1 W & F	
111	661 to 666	,, *parviflora* ...	44	5	1	1 F	
114	679 to 684	*Lagerstroemia hypoleuca.*	44	6	...	...	
115	685 to 690	*Melanorrhoea usitata*	44	6	...	...	
116	691 to 696	*Pentace burmanica...*	44	5	1	...	
118	703 to 708	*Soymida febrifuga* ...	44	6	...	...	
123	733 to 738	*Shorea obtusa* ...	41	5	1	...	
124	739 to 744	*Pentacme suavis* ...	41	6	...	...	
125	745 to 750	*Dysoxylum malabaricum.*	38	6	...	...	
135	805 to 810	*Calophyllum elatum*	32	3	3	...	
137	817 to 822	*Berrya ammonilla...*	31	4	2	...	

Serial number.	Number of specimen.	Species.	Period under test (in months).	A.	B.	R.	REMARKS.
140	835 to 840	*Quercus lineata* ...	29	5	1	..	
143	853 to 858	*Chickrassia tabularis*	27	2	4	...	
144	859 to 864	*Michelia montana* ...	27	4	2	...	
145	865 to 870	*Amoora wallichii* ...	22	6	...	...	
147	877 to 882	*Terminalia manii*...	22	3	3	..	
148	883 to 888	*Dipterocarpus griffithii.*	22	5	...	1 W & F	
151	901 to 906	*Lagerstroemia lanceolata.*	16	5	1	...	
152	907 to 912	*Albizzia odoratissima*	16	6	...	...	
153	913 to 918	*Xylia xylocarpa* ...	16	6	...	...	
154	919 to 924	*Lagerstroemia flos-reginae.*	16	6	...	...	
155	925 to 930	*Dipterocarpus zeylanicus.*	16	6	..	...	
156	931 to 936	*Hopea glabra* ...	14	5	1	...	
158	943 to 948	*Podocarpus nerifolia*	12	6	...	...	
160	955 to 960	*Cynometra polyandra.*	12	6	...	...	
161	961 to 966	*Gmelina arborea* ...	12	6	...	...	
162	967 to 972	*Careya arborea* ...	12	6	...	...	
163	973 to 978	*Acacia arabica* ...	12	6	...	...	
164	979 to 984	*Machilus macrantha*	12	6	...	...	
165	985 to 990	*Terminalia myriocarpa.*	12	6	...	...	White hollock.
166	991 to 996	*Terminalia myriocarpa.*	12	6	...	...	Black hollock.
167	997 to 1002	*Carapa moluccensis*	11	6	...	...	
168	1003 to 1008	*Canarium strictum*	11	3	1	2 W & F	
169	1009 to 1014	*Anisoptera glabra* ...	10	6	..	...	

Serial number.	No. of specimen.	Species.	Period under test (in months),	A.	B.	R.	REMARKS
170	1015 to 1020	*Lagerstroemia* spp...	10	6	...	...	
171	1021 to 1026	*Acacia arabica* ...	9	5	..	...	One short.
172	1027 to 1032	*Acacia catechu* ...	9	5	...	...	Do.
173	1033 to 1038	*Artocarpus integrifolia.*	9	1	...	.	Only one available.
174	1039 to 1044	*Artocarpus lakoocha*	9	3	...	...	Only three available.
176	1051 to 1056	*Hopea cordifolia* ...	8	6	...	...	
179	1069 to 1074	*Lophopetalum wightianum.*	7	6	...	...	
180	1075 to 1080	*Cinnamomum inunctum.*	3	6	...	...	
181	1081 to 1086	*Vitex altissima* ...	3	6	...	...	
182	1087 to 1092	*Cinnamomum iners*	3	6	...	...	
183	1093 to 1098	*Terminalia arjuna*	2	6	...	...	Only 4 available.
184	1099 to 1102	*Terminalia arjuna (sap).*	2	4	...	...	
185	1103 to 1106	*Terminalia arjuna (sap & heart).*	2	4	...	...	
186	1106 to 1110	*Terminalia arjuna (heart).*	2	4	...	...	

TABLE 2 (*b*).

DURABILITY TESTS ON UNTREATED INDIAN TIMBERS.

Incompleted tests arranged in order of time ; no class A remaining.

Serial number.	Number of specimen.	Species.	Period under test (in months).	A.	B.	R.	REMARKS.
1	1 to 6	*Anogeissus acuminata*	66	...	2	3 W & F	One stick remove for use.
12	67 to 72	*Eugenia kanarensis*	66	...	2	4 F	
17	97 to 102	*Terminalia oliveri* ...	62	...	2	4 W & F	
49	289 to 292	*Grewia tiliaefolia* ...	53	...	3	3 W & F	
51	301 to 306	*Albizzia procera* ...	53	...	6	...	
69	409 to 414	*Calophyllum wightianum.*	50	...	3	3 W & F	
78	463 to 468	*Dichopsis elliptica* ...	50	...	1	F	
86	511 to 516	*Kayea assamica* ...	49	...	4	2 W & F	
93	553 to 558	*Dipterocarpus alatus*	6	...	4	2 W & F	
105	625 to 630	*Dalbergia paniculata*	44	...	1	5 W & F	
112	667 to 672	*Heritiera minor* ..	44	...	1	5 F	
128	763 to 768	*Schima wallichii* ...	34	...	3	3 W & F	
134	799 to 804	*Morus alba* ...	32	...	2	4 W & F	
149	889 to 894	*Michelia excelsa* ...	16	...	2	4 F	
150	895 to 900	*Pterospermum acerifolium.*	16	..	1	5 W & F	
157	937 to 942	*Abies webbiana* ...	13	...	1	5 W	
159	949 to 954	*Stereospermum suaveolens.*	12	..	3	3 W & F	
178	1063 to 1068	*Juglans fallax* ..	7	...	5	1 W & F	

DURABILITY TESTS ON INDIAN TIMBERS.—TESTS PROCEEDING.

Selected species of promising durability.

A. (*a*) No rejections or termite attack in 4-5 years.

Terminalia arjuna	Period of test	58 months.
Dalbergia sissoo	Do.	58 ,,

Dalbergia latifolia	Period of test	58	months.
Pterocarpus dalbergioides	Do.	57	„
Hardwickia binata	Do.	53	„
Mesua ferrea	Do.	50	„
Shorea robusta	Do.	49	„

Note—Some of these are being attacked with fungus.

(*b*) No rejections or termite attack in 3-4 years.

Heterophragma adenophyllum	Period under test	45	months.
Castonopsis tribuloides	Do.	44	„
Dalbergia oliveri	Do.	44	„
Dysoxylum binectariferum	Do.	44	„
Eriolaena candollei	Do.	44	„
Gluta tavoyana	Do.	44	„
„ *travancorica*	Do.	44	„
Hopea parviflora	Do.	44	„
Lagerstroemia hypoleuca	Do.	44	„
Melanorrhoea usitata	Do.	44	„
Soymida febrifuga	Do.	44	„
Shorea obtusa	Do.	41	„
Pentacme suavis	Do.	41	„
Dysoxylum malabaricum	Do.	38	„

(*c*) No rejections or termite attack in 2-3 years.

Calophyllum elatum.	Period under test	32	months.
Quercus lineata	Do.	29	„

B. (*a*) No rejections but some attack by white ants in 4-5 yrs.

Ougeinia dalbergioides	Period under test	58	months.
Parashorea stellata	Do.	58	„
Albizzia procera	Do.	53	„

(*b*) No rejections but some attack by white ants in 3-4 yrs.

Calophyllum tomentosum	Period under test	47	months.
Pterocarpus marsupium	Do.	46	„
Pentace burmanica	Do.	44	„

(*c*) No rejections but some attack by white ants in 2-3 yrs.

Berrya ammonilla	Period under test	31	months.
Chickrassia tabularis	Do.	27	„
Michelia montana	Do.	27	„

PRIZE-DAY AT THE FOREST COLLEGE, DEHRA DUN.

The following speech was delivered by Mr. A. D. Blascheck, F.C.H., Oec.D., Inspector-General of Forests and President, Forest Research Institute and College, on 31st October, 1931, at Chandbagh, on the occasion of the distribution of certificates and prizes to the successful students of the Indian Forest Service Class, 1929—31 :—

" I am sorry that we meet to-day knowing that the I. F. S. College is to be closed, temporarily at any rate. The decision was almost inevitable in view of the few recruits to the service that will be needed for some years, and it was an obvious way of helping to meet the prevailing financial difficulties. The two remaining students will complete their course at Dehra Dun and the College itself may become the new Indian Military College.

" It is unfortunate that the College has to be closed so soon after its foundation, but there is no real occasion for gloom or depression. It is almost certain that it will have to re-open in the course of a few years and I very much hope that it will be in even closer association with the Forest Research Institute where all the most modern facilities are available for studying forestry in all its aspects. At any rate you students who are being awarded diplomas to-day are joining a service that has a reputation which will not be shaken by the momentary needs of retrenchment, and there is unlimited scope for you to apply what you have learnt during your course and so add to the forestry achievements of India. You have made prolonged tours in the forests of the United Provinces, Punjab, Bengal and Assam, and have acquired first hand information about what has already been done and what remains to be done in forests grown under a wide variety of conditions. I hope this knowledge will not only be an ncentive to you in your own careers, but that it will enable you to take your part in creating public opinion in support of scientific forestry in India.

" The ignorance among people not directly concerned is amazing both as regards the methods and objects of forestry, and

it is most important that every forest officer should try and remove the apathy that is so common.

"The three Government students give every promise of maintaining the standard of efficiency associated with the diploma of the College.

"S. Venkateswaran from Cochin State had the misfortune to miss four important months of the course through ill-health, but I hope to be able to award him a diploma after making a short further tour of instruction. I regret that I am unable to award a diploma to P. A. Menon.

"I am glad that you have all taken your part in games and sports with the Ranger students.

"Before proceeding with the distribution of diplomas and prizes I am sure you will all join me in recording our thanks to forest officers who have taken so much trouble to make your tours a success; in particular to Mr. Shebbeare, Conservator of Forests, Northern Circle, Bengal, who accompanied you through the very interesting forests of which he has charge.

"Finally we have to record with regret the departure of your lecturer, Mr. Trigg, who went on leave last December and to welcome Dr. Gorrie in his place. And now we have to bid farewell to Mr. Osmaston who has been Principal almost throughout the course now completed. He has taken a very great interest not only in your training, but in all aspects of your life at the College and I am sure you students are very grateful to him and wish him all good wishes in the Circle to which he now returns."

Diplomas were awarded as follows :—

1. P. Venkataramany	...	Government Probationer.
2. Abdul Hamid Khan	...	Do.
3. M. M. Srinivasan	...	Do.

Prizes were awarded as follows :—

1. Hill Memorial Prize for Silviculture	...	P. Venkataramany.
2. McCrie Memorial Prize for Management	...	Do.

3. Hon'ble Member's Prize for the best Practical Forester	Abdul Hamid Khan.
4. 'Indian Forester' Prize for Botany ...	Do.
5. Surveying and Drawing Prize	M. M. Srinivasan.
6. Zoology Prize ...	Do.

P. Venkataramany qualifies for the prize awarded out of the Currie Scholarship Fund to the student obtaining the highest marks in the final examinations.

The following prize is also to be presented :—

Mason Jaspal Cup for Lawn Tennis, Singles (I. F. S. College)—Syed Asad Ali Anvery.

BRITISH ASSOCIATION FOR THE ADVANCEMENT OF SCIENCE—CENTENARY MEETING: LONDON, 23rd—30th SEPTEMBER, 1931.

FORESTRY DEPARTMENT K.

CHAIRMAN: SIR ALEXANDER RODGER, O.B.E.

Programme.

Thursday, 24th September. 10 a. m. ... Discussion on Wood Preservation.

(1) Research in Wood Preservation—R. S. Pearson, C.I.E.

(2) Toxicity of preservatives against wood destroying fungi—K. St. G. Cartwright, B. A.

(3) Prevention and Control of Damage by Wood boring Insects—R. C. Fisher, B.Sc., Ph. D.

(4) A chemical approach to the study of Wood Preservation—W. G. Campbell, B.Sc., M.S.

(5) Methods of applying wood preservatives—J. Bryan, M. Eng., A.M. Inst., C.E.

Exhibition illustrating Wood Preservation, by the British Wood Preserving Association.

Afternoon. Visit to Princes Risborough.

Friday, 25th September. 10 a. m. ... Empire Forestry.

(1) Chairman's Address—Forestry in the Empire during the last 100 years.

(2) Empire Forestry during past Decade—Sir R. L. Robinson, O.B.E.

(3) The Empire Forests as a Resource—Fraser Story.

Afforestation Work in the Plateau Central of France.—Professor E.P. Stebbing.

Afternoon. Visit to Timber Yard. (Howard Bros.)

Saturday, 26th September. ... Excursion to Bedgebury.

Sunday, 27th September. ... Excursion to Rendlesham Forest Area near Ipswich.

Monday, 28th September. 10 a. m.... Presidential Address by Professor T. G. Hill. To be followed by discussion on "Training for Government and Industrial Services."

Afternoon. Excursion to Wisley.

Tuesday, 29th September. 10 a. m. ... "Site"—R. Bourne.

10-45 ... The Culbin Sands—J. F. Annand, O.B.E.

Tuesday, 29th September.	11-30	... Preliminary Stages of an Investigation into Various Races of European larch—Dr. M. L. Anderson.
	12-15 p.m.	British Forestry and the Philosophy of Action—Dr. A. S. Watt.
	5 p. m.	... Talking Film—Sirex Wood Wasp.
Wednesday, 30th September.	10 a. m.	... The Marketing of British Timbers—J. S. Corbett, O.B.E.
	10-45	... British Grown Hardwood Trees —Alex. L. Howard.
	11-30	... The Effect of Progressive Fungal Decay on the Mechanical Strength of Timber—W. P. K. Findlay, B. Sc.
	12-15	... Studies in the Biology and Forest Relations of the Pine Shoot Moth, Evetria (Rhycatonia) bouleana, Scheff, by the late Clement Crawshaw Brooks, M. Sc. (Manch.)

FORESTRY SUB-SECTION, BOTANY SECTION, BRITISH ASSOCIATION, CENTENARY MEETING, LONDON, SEPTEMBER 25TH, 1931.

CHAIRMAN'S ADDRESS.

Forestry in the Empire during the last hundred years.

"In attempting to compile a short account of Forestry in the British Empire during the last 100 years, I have been struck by the fact that almost the whole of the history of scientific importance, with a few notable exceptions such as India, is confined to the present century. It is true that forests have played quite a large part in the development of great countries such as Canada and Australia, but Forestry as a science has been, until recently, entirely neglected in many parts of the Empire. I would go even farther and say that many of the most important

doctrines held by the forester have been consistently violated on a very large scale, with the result that the forest capital of several important countries has now been very much reduced. In the majority of the places concerned the story has been very much the same. The forests, if not actually regarded as an incumbrance of the ground, and a hindrance to the immediate development of the country for the purposes of agriculture, were considered to be a species of gold mine from which all the valuable products could be extracted and sold, none of the revenue so realised being put back in the form of maintenance and improvement. There were a few striking exceptions to this process, India being the most important, and Ceylon, Mauritius and New Zealand are among others which may be mentioned.

It is probable that the exploitation of forests, at any rate in the tropics, began with the practice of shifting cultivation. The practice has been widespread in many parts of the world up to the present day and was prevalent among the Mayas of the ancient civilization of Central America. Patches of forest are cut and burned and one or two crops are taken off the ground before the cultivator moves elsewhere to repeat his felling and burning. This destructive method of cultivation has undoubtedly been responsible for many changes, and usually deterioration, in tropical forests, as soft woods and bamboos nearly always occupy such areas and take the place of more valuable timber trees, and it may take many years, even centuries, before the timber trees find an opportunity of retaking their rightful place. It is estimated that at the present time some 2,000 square miles are destroyed by this method annually in Nigeria alone. In Kenya and Ceylon large areas of forest have been destroyed, and in many other parts of the Empire the process still goes on.

The energy and ability of the cultivator have been taken advantage of to introduce plantations of useful trees among the agricultural crops, the method having been first introduced in Burma with teak about 1870. It has spread during the present century to India, Africa and elsewhere and has attained very considerable importance, as an effective method of introducing

valuable hard-woods into areas which may have been devastated many years ago or may never have been of value.

In most parts of the Empire where valuable forests existed, heavy and wasteful exploitation began as soon as a use was found for timber, and, without dwelling on the record of this depressing period, I shall try and trace briefly the history of conservation and control.

The story has often been the same. Startled by the destruction and waste of an important national asset, Governments have usually pushed through legislation to enable them to make State reserves, to appoint officers of a Department of Forestry, and to control the excessive felling by traders and licencees. These laws, which to begin with were better than nothing, have usually been amended, improved and made stricter by subsequent enactments, and it is not difficult to realise that the early legislation was often very defective.

As a preliminary to the introduction of systematic management it was customary to employ a trained forest officer, usually from India, to report on the forests and the measures to be taken to preserve them, and many of the old reports then produced are of the greatest interest. These officers not only examined and reported on the forests in detail, but also made proposals for staff, reservation, afforestation and so on, and sometimes even drew up preliminary working plans.

In one case a Japanese was engaged to inspect the forests of a British possession, but I have not been able to find his report.

We must not forget the large extent to which Forestry was influenced by Botany during the early years and much of the progress made was due to the efforts of distinguished botanists, both British and foreign, who were quick to see the damage that was being done to the forests and the opportunities that still existed of conserving and improving the timber resources. Several excellent reports on the forests of India and Burma were written by botanists and it is curious to find that some of these have not yet been superseded by any modern work of equal merit.

Mention should also be made of a number of Army Officers who showed a special aptitude for preliminary forest work and occupied important positions before the advent of trained forest officers. This is the place to mention two great Empire Foresters, both Germans, Sir Dietrich Brandis and Sir William Schlich.

A hundred years ago the old forest rules were in force more or less in Great Britain, Mauritius, and one or two other places, but for the most part the forests were free to the people, like air and sunlight, and were valued as lightly.

The Ceylon Forest Ordinance was passed in 1840 and regulations to protect certain forests in New Zealand were made in 1841. An old Act of 1859 in S. Africa is called the Forest and Herbage Act of Cape Colony. The Indian Forest Act was passed in 1865, marking the beginning of proper modern legislation to protect forests in the Empire.

Up to the year 1900 little progress was made in this direction in other parts of the Empire, but certain tentative efforts before that date were made in Cyprus, New Zealand, South Africa, Great Britain, South Australia, Ontario and elsewhere. During the last thirty years the development of measures of protection has been rapid. In almost every part of the Empire the State has made great efforts to obtain control of the remaining valuable forests which have been sometimes reserved, sometimes completely protected by an adequate staff, and sometimes controlled as regards felling by traders and permit-holders.

It has been the rule, rather than the exception, for these measures to arouse opposition, not only from the inhabitants of neighbouring villages, who naturally considered that their vested interests were being interfered with, but also from more enlightened people, officials and others. It has often happened that the Forest Departments were regarded as oppressors, the people and sometimes officials being quite unable to understand that the forests stood in any need of protection.

The good work, however, made great strides between 1900 and 1930 in Canada, Australia, Tasmania, New Zealand, the

Malay States, West and East Africa, Borneo, Fiji, British Honduras, British Guiana, the West Indies, Palestine, Tanganyika and Cyprus. British Somaliland represents probably the most primitive country in the Empire as regards development of its natural resources. There is no Forest Department and shifting cultivation has done a good deal of damage but a start has been made in inducing the natives to plant trees and certain areas of cedar have been preserved. In Kenya the area of forests is very small, only 6 per cent. of the inhabited area of the Colony, but the pencil cedar is a valued product and scientific management of the forest is well in hand.

Ceylon is a colony where forest management has been in force for a long time, but it was noted at the Australian Conference in 1928 that "up to quite recently, our main work in Ceylon has been the exploitation of our hard-wood forests for the supply of timber to public departments at cost price." This unfortunate system had most undesirable results as exploitation was looked upon as the main duty of the forest officer.

A census of woodlands of Great Britain has been completed, the total area being only 4,700 square miles of which a good deal is classed as unprofitable. Great Britain, Spain, Greece and Australia seem to come well at the bottom of the list showing percentage of area under forest in each country, and Great Britain can at present supply only about 5 per cent. of her annual timber requirements. Small places such as Trinidad, Tobago, Dominica, Antigua and Hong Kong have been reported on and a certain amount of interest is taken in their forest growth. In Hong Kong, in 1920, 8,000 pine plants were put out on bare hills and there is a botanical and forestry service with two Europeans.

In 1920, 1923 and 1928, Empire Forestry Conferences were held in Great Britain, Canada and Australia respectively. These proved of the greatest value in co-ordinating forest work throughout the Empire, in bringing forest officers together, in encouraging the care of forests in every possible way, and perhaps greatest of all, in the creation of a "forest sense". By "forest sense" I mean a general feeling among the population that forests

are an essential and natural part of the life of a nation, that the country cannot get on without them, any more than it can without air and light. Such ideas have existed for many years in some of the countries of Europe, notably Germany, France, Austria and Switzerland.

Among the important subjects dealt with at the Conferences were :—

Survey of Resources,
Protection of Forests from Fire,
Forest Research,
Forest Education.

It will be evident that, in estimating the forest resources of the Empire, the figures must be in some cases only approximate. Indeed a number of countries have been unable to give any exact details. A useful beginning has been made, however, in estimating the areas under forest, both accessible and unprofitable, and the quantity of timber that may be made available. Details of this kind will become more valuable year by year as surveys and working plans cover more and more of the remote areas, and it will suffice to mention here that India has 230,000 square miles of forest, Canada nearly a million, Australia 38,000 and New Zealand 18,000.

The following resolution was adopted by the third Empire Forestry Conference held in Australia in 1928 :—

"The widespread damage to timber, property and life resulting from uncontrolled forest fires is a menace to the economic well-being of the British Empire, and constitutes the greatest single deterrent to the practice of forest management."

This resolution had particular reference to Canada.

Forest Research has made great strides in the Empire during the present century. The number of subjects covered is very large indeed and includes comprehensive investigation into silviculture in all its branches, including forest management on modern lines, nursery and plantation work, the protection of hills and slopes against erosion, and the use of valuable exotics, for

example conifers in Australia, New Zealand and South Africa and eucalyptus in S. India.

On the side of Forest Utilization or Forest Economy great progress has been made in the investigation of the uses of timber and minor forest products such as dyes, tans, oils, resins, lac and pulp from bamboos. Other useful lines of enquiry are seasoning of timber, antiseptic treatment of railway sleeper and other woods, the structure of timber and the qualities of timber as regards strength and elasticity.

Under the head of Protection the most important items are the control of damage done by insects and fungi, damage which has attained great dimensions in many forests in tropical and temperate regions.

Forest Research has been carried out principally in India, and also to a certain extent in Great Britain, the Malay States, Canada and elsewhere, and is steadily increasing in importance.

A most important development as regards Research and Education has taken place recently at Oxford where the Imperial Forestry Institute has been established. Although badly hampered in its work by lack of funds, under the admirable guidance of Professor Troup this Institute has already made great progress and has attained a commanding position in the Empire as the centre of Forest Research, Forest Education, and a means of disseminating technical information.

The training of forest officers of the higher grades for service in the Empire began in this country in 1885 at Cooper's Hill, and after 1900 it was taken up by several of the Universities in Great Britain, Canada and elsewhere. A Committee appointed by the Government went fully into the whole matter during the present year and expressed the opinion that four years were necessary to train a forest officer. The importance of maintaining a supply of properly trained experts cannot be over-estimated.

To sum up, we may say that we have a forest estate of about 2 million square miles, that large parts of this have been grossly misused in the past, but that the prospect at the present day that

the forests will now be properly managed is good and that an increasingly valuable asset will be assured for the Empire."

Marketing of British Timber.

In the Forestry Department of Section K, Mr. J. S. Corbett, of the Empire Forestry Association, discussed the marketing of British timber.

The scientific side of forestry, he said, had made vast strides, but little had been done to improve the marketing of home-grown and Empire-grown timber. It was futile to spend vast sums of money on planting, research and advertising unless there was a reasonable possibility of the resultant trees finding a ready market in competition with the outside world and prices which would show a reasonable profit. There was always a demand for first-grade hard woods, but for lower grades it was difficult to find a buyer. With regard to soft woods he viewed the future with alarm.

A Selling Agency.

Of the soft woods used by the British railways 71 to 90 per cent. was of foreign origin, and of the hard woods 6 to 49 per cent. Home-grown soft woods might not be good enough in quality for general construction and rolling stock, but he suggested that a larger percentage of this might come from Canada. When they came to sleepers, fencing and scantlings of lower grades, home-grown timber might play a very prominent part, and, in co-operation with Canada, very materially reduce the foreign imports. It would be going too far to say that the huge amount required for sleepers alone could be found in Great Britain in the near future, but if a market could be found for the soft woods which to-day nobody wanted nothing would do more to hasten the replanting of areas devastated during the War. A central selling agency would be necessary to deal with the railways, as the companies would not deal with sellers scattered throughout the country, and they must be assured of regular supplies in bulk and of adherence to specification.

In the case of collieries, the shipping industry, and the building and furniture trades, it would, he suggested, probably be found that it was only lack of marketing organization that precluded orders for British timber. By more economical conversion, handling and distribution, he believed prices could be considerably reduced.

He had ignored one very important factor, the unfair competition from Russia. While the present unrestricted importation was allowed, he could see no hope of salvation for the soft wood grower. Timbers good enough for box-making and sleepers were being offered at prices which barely represented the labour costs of felling, conversion and transport of home-grown timber.

OLD ENGLISH AVENUES.

Mr. Alexander L. Howard, in a paper on "Our British-grown Hardwood Trees," quoted from recent articles in *The Times* describing old English avenues, and asked how should we be accounted by those who followed us when, too late, it was discovered that we had wasted our woodlands, making no efforts to replace them? Before the War we had in the British Isles a really large reserve of hard wood timbers, but, apart from the fact that the War itself consumed a vast quantity, we had from the beginning of the post-War period been destroying every tree which would produce for the owner even the smallest possible sum to help him pay his taxation.

The small remaining reserve of immature forest should be preserved so as to reach its full growth and at the same time re-planting should be encouraged in every direction. Taxation of woodlands should be entirely removed, and the opposite course should be adopted of granting bounties for hard wood plantation. Were we inferior in practical sense to the German or the Yugoslav or the New Zealander? If not, a law prohibiting the felling of immature trees should be enforced by a Forestry Department moulded on lines similar to those approved elsewhere, and with

a judicious use of funds scientific planting should be encouraged.

(*The Times*).

FORESTRY.

Forestry was represented at the Centenary Meeting of the British Association in London this year and had a successful session. The attendance at some of the lectures was good and at others poor. More publicity is required and it is hoped that in future years forest officers, both on leave and retired, will be kept informed of the meetings as very few of them attended this year. It is also desirable that the Forestry sub-section should be made rather more important, as it is at present very much overshadowed by Botany.

A VISIT TO THE LOLAB FORESTS.

BY C. G. TREVOR, I.F.S.

Last July through the courtesy of Mr. H. L. Wright, the Chief Conservator, Kashmir, I was able to pay a visit to the Lolab Forests and to see a good deal of forest operations in this and the neighbouring forest divisions of the Kashmir province. Mr. Jamwall in his article in the October number of the "Indian Forester" has given a short account of the shelterwood system which was adopted in 1924. My impression of these forests was that they were entirely suitable for treatment under this system and that given plenty of seed regeneration should present no great difficulty. Owing to the fact that for 8 years there was no seed not much progress was to be expected, especially as it is only recently that any attempts have been made at sowing and planting. With a few exceptions where either sufficient seed trees did not exist or where the seeding felling was to my mind rather too heavy the regeneration fellings had been well done and the soil was in a suitable state for the reception of the seed. One thing is rather remarkable and that is that at the time of seed fall in 1930 there can have been no wind, as the only natural regeneration is immediately below the seed trees. The seed trees also have not produced the seed they should have,

due, I think, to the restricted size of their crowns, this is a matter which should rectify itself. The artificial work, chiefly broadcast sowing and sowing on burnt patches, which was initiated by the Divisional Forest Officer, Mr. Haqiqat Singh, in 1930 has given very good results. Indeed the seedlings are so thick on the ground that they will have to be thinned out later. In the Punjab sowings have been restricted to 10 pounds of deodar seed per acre, the equal of 40,000 seeds, which should surely be sufficient for complete stocking. The nurseries I saw were also excellent. Artificial reproduction only succeeds when the greatest attention is paid to every detail and the proper technique is carried out. Unless this is done money spent on this work is just thrown away. It is only the local officers who can see that this is done, and it gave me much pleasure to see the excellent nurseries which had been laid out in the Lolab in readiness for the next planting season. In Kashmir, which has not a monsoon climate, an entirely different planting season has to be adopted. Planting in the monsoon season is useless and the work has to be done in the spring exactly as in Europe. This is rendered possible in Kashmir by the good rainfall at this season. I am not surprised to read of the failure of forest transplants as my experience with them has always been unsatisfactory and it really costs no more to grow good transplants in a nursery. These deodar forests of the Lolab are incomparably finer than anything in British India and are ideal for the practise of the most detailed forest management. I would take this opportunity of urging that increment should not be considered in calculating the yield of P. B. I. under the Uniform System. My experience has been that it is much wiser to keep increment in reserve in case of delay in establishing regeneration, damage from fire or any other such cause. The increment is not lost but is only deferred and comes into any calculation of a revised yield later on. It is always better to be able to increase the yield than to have to reduce it and the latter event is only too common at the present time in India. Kashmir would be well advised to reduce its yields forthwith as at present the outturn of timber is greater than the demand.

PEG SOWING OF CHIL SEED.

BY KHAN SAHIB ALLAH BAKHSH, I.F.S.

In the ordinary course much of the seed sown broadcast is washed down by rain and it seldom lies on steep ground. Peg sowing was tried in one acre in Compartment 23, a P.B.I. area. Another acre was sown broadcast close by for comparison. It was found that peg sowing gave far better results than broadcast sowing.

It was originally intended to make a small hole by pushing the end of a stick in the ground and to place 2 to 3 seeds in the hole so that they come in contact with the soil at once and were not washed down by rain, or in other words to give the seed the best natural lie. The actual work was, however, done by means of an old iron peg about $1\frac{1}{2}$ lb in weight and $1\frac{1}{2}''$ in circumference with a pointed end. It was driven into the ground by hand and saved much time and labour. Wooden pegs of slightly smaller size were also used and were driven into the ground by means of a stone. These took a little longer time. The holes were made $1\frac{1}{2}''$ to $2''$ deep and 2 to 3 seeds were placed in each hole and left uncovered.

Seed thus sown germinated much earlier than that sown broadcast and in every respect gave better results. It appears that the seed in the holes secured a better supply of moisture and it came immediately in contact with the soil which is not the case in broadcast sowing; hence early and more vigorous germination.

Peg sowing was done by two Forest Guards and a Forester in one acre and the operation cost nothing. Another adjoining acre, where patch sowing was done, cost Rs. 2 per acre for making patches alone and the result was not as good.

This method may not be very successful on level ground with a sandy soil, as the holes are likely to be filled up with sand at the first heavy down pour, but it seems to be admirably suited to moderate and steep slopes where seed is likely to be washed down or is more likely to fall on cattle tracks where

the seed and seedlings are trampled down and killed. It needs much less seed than required for broadcasting and patch sowing per acre. At the same time spacing can be so arranged that no cleaning would be necessary for running a ground fire when the young crop is big enough to stand a departmental fire.

A TRIP DOWN THE SIMSANG VALLEY OF THE GARO HILLS.

By R. N. De, I.F.S.

The Garo Hills District in Assam is "wild," though not exactly in the back of the beyond, but some parts of it are off the beaten track, that is away from the usual *sarkari* road or bridle path. To a traveller such tracts have a peculiar fascination of their own.

The Simsang river rises in the Tura Range and flows due north up to the Arbela hill and then, turning almost due east and again south, it cuts through the eastern end of the range. The banks are precipitous till it debouches into the plains of Mymensingh near Bagmara, a trading centre on the borders of the hills, where it widens out to about half a mile and is known to the Bengalis as the Someswari river. In the plains it flows tranquilly, but in the upper reaches it forms pools and rapids studded with huge boulders, through which it passes as a raging torrent.

On its banks there are some Reserved sal forests, the most important of which is the Rongrenggiri Reserve. This Reserve, which contains some of the finest sal trees in India, has not been worked on a large scale as communications are difficult. Trees about 100′ high and 8′ and over in girth are quite common. The lead from the Reserve to the markets in the plains is long and the expense of making a road up to the Reserve and maintaining it would be excessive. If the river could be trained for floating there would be an inexpensive means of transport and the sal timber could be floated out by means of bamboo rafts, bamboos being abundant in the forest. That such floating is not beyond

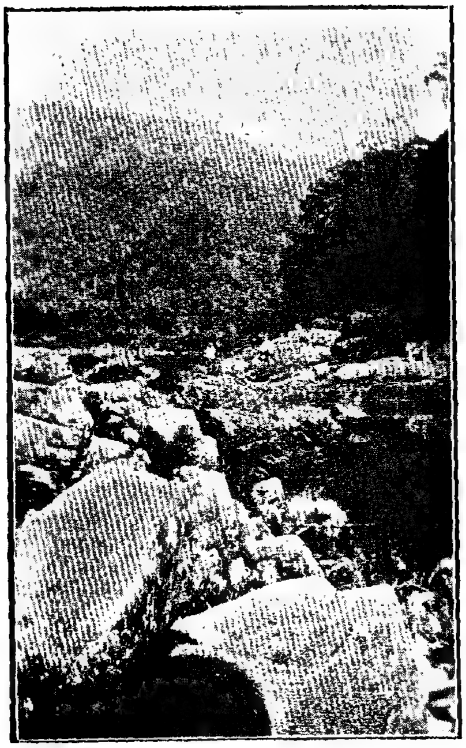

Fig. 1.—Mrikwari. The pool is seen on the right.

Fig. 3.—Nongwalbibra. Landslip in the background.

Fig. 2.—Dingjachekwæ.

(Photos by R. N. De, I.F.S.)

the range of possibility has been demonstrated by the writer by floating down 4 big sal logs (about 14′ long and 4′ 6″ girth, dressed) unattended, with two bamboo floats tied to their sides. Considering the obstacles encountered, it is a wonder that one of the logs reached Bagmara, on the borders of the district where every stick is saleable if only the timber could be got down there. Garos living near Bagmara have been known to float timber down the Simsang, but to what extent no one knew. The *Raison d'être* of my journey was to explore the Simsang bed with a view to the removal of obstacles that stand in the way of floating.

After making the necessary arrangements for camping and food-stuffs, we set off from Rongrenggiri, where there is a forest camp. Touring generally in the Garo Hills is more difficult than in any other hill district in Assam, as no supplies are available and one has to carry even fowls and eggs. There is no dearth of pigs and fowls in some villages, but they are mostly kept for sacrifice to various *mite* (spirits) or for a festive occasion. The river was reported to be navigable for a day's journey and we arranged two dug-outs to carry myself and my Ranger, our kit being sent overland to the next camp. We passed through a good many rapids where the boatmen (Garos) did not get out of the boats but steered them with bamboo poles. The pools abound in fish, mostly mahseer. Some otters were seen in the deeper pools, but my attempt to shoot them was ineffectual as they hid in the jungle on our approach. Snipe were also met with on the wet sand-banks near the water's edge, which are covered with small shrubs and grass. Many Garo women were noticed busy collecting small molluscs in the shallow water with a small bamboo. These they use as a substitute for fish. About three hundred yards from Ranbinggiri village, the river narrows between high rocky banks through which it foams. Plate 2, photo 1, shows the place locally called Mrikwari. Many otters were also seen here.

The first formidable obstacle to floating we encountered was the Dingjachekwae. Two big boulders almost block the passage of the water, which flows through a small gap in between

(photo II). The Garos say that a legendary spirit named Gonga used to catch fish there with a net and hence the name. As we proceeded we passed many rapids and pools, the longest being Matma wari. In this section the river passes over several rocky shelves which cause small falls. Before Matma wari is reached a deep pool called Ganaminokram is met with and it is said that some Garo women went to bathe in the pool and left their clothes (Gana) on the bank, which were swallowed up by the pool. Hence its name.

Further down the river, we passed many rapids and pools but the most difficult obstacle in this section is called Marshakdara, a rapid near Rongkandi. Further down a stream named Nongwal flows into the Simsang (photo III) down which timber is floated by the local Garos. A recent earthquake has caused a big land-slip on the bank of the Nongwal, but this has not impeded the flow of the stream. A coal seam about 4′ thick runs along the land-slip on either bank, but it is not worked by anybody.

The vegetation down the Simsang beyond Rongrenggiri is worthy of note. It has previously been mentioned that the Rongrenggiri Reserve constitutes one of the finest sal forests in India, but outside the Reserve sal is conspicuous by its absence, although the formation and elevation are similar. The trees most frequently met with are *Odina wodier* and *Schima wallichii*. *Jhumming* and exploitation are probably responsible for this. The first discovery of *Nepenthes* (pitcher plant) in the Garo Hills was made in the neighbourhood of Nongwalbibra. It was growing on a precipice and was difficult to get at, but after some attempts a few specimens were collected.

We continued our journey along the river bed, the country here being much more rugged and steep and intensively *jhummed*. We passed a village called Dobakol, meaning a bat's nest. Its name is derived from a lime stone cave in which bats are found in hundreds. A much larger cave, which has not yet been fully explored, exists near Siju village in the southern part of these hills. It is said that some geologist went into it for about a quarter of a mile.

Fig. 4.--Rangrani dare looking down. Notice the rock obstacle in the foreground.

Fig. 5.—Rangrani dare looking up. Notice the rock obstacle in the centre The stream flows to the right and left of the rock.

Fig. 6.—Platform for dragging timber over it is shown on the left, the stream is flowing on the right.

(Photos by R N. De, I.F.S.)

Near the junction of the stream called Rangrani the river bed is obstructed by a solid mass of rock (quartzite) which admits of the flow of water only through narrow channels, one of which is open only during the rainy season. We were told by the local people that one of the channels, which still flows, was not obstructed till huge boulders fell into it during the 1897 earthquake. Plate 3, photos IV and V show the obstacle.

The Garos of the southern part of the hills are adepts at dragging and floating timber. In fact, a large number of people make a living by the sale of timber and dug-outs they extract from the upper parts of the Simsang. The obstacles in the river do not deter them from carrying on their trade, although it becomes restricted. Where they cannot float and the obstacle is too great to overcome, they erect a platform over which they drag their timber. Photo VI shows a platform on the left hand side, while the rock forming the obstacle is on the right.

It has been stated above that sal forms the main crop in the Reserve and that outside it miscellaneous species are met with, chiefly *Odina wodier* and *Schima wallichii.* This applies to the hill tops, but on the slopes and shelving banks on both sides, a characteristic evergreen forest is met with, and *Mesua ferrea, Isonandra polyantha*, *Cynometra polyandra* etc., are very common. A little beyond Badri the sal again appears on the hill tops and becomes gregarious in the Reserves in that locality, and bamboos and *Musa* spp. take the place of other evergreens. From Badri the Simsang becomes rather a tame river and logs and dug-outs are regularly floated down to Dagmara without any serious difficulty. We, therefore, returned feeling satisfied that we had not missed some of the most beautiful scenery in the Garo Hills.

EXTRACTS.

STEEL SLEEPERS.

The question of railway sleepers, whether they should be of timber or steel, and if of steel of what particular design, is still in an indeterminate state. In England, an iron and steel country, the wood sleeper was preferred, as a sleeper it answered the purposes of a sleeper better, and though it had to be imported it was cheaper. In India it was in a sense the other way, the engineers liked the wooden sleeper just as much as they did in England, but India, not a great steel-manufacturing country, has immense State forests capable of supplying the timber article, while metal sleepers have to be imported from a distance. All the same, the metal sleeper was the cheaper and it could always be obtained from the manufacturers in any quantities on the tick of the clock as required, when the Forest Department might have a difficulty in meeting an indent. The steel sleeper therefore prevailed, and it became a question whether in the interests of the State the wooden sleeper, in spite of the objections mentioned, should not be

used. It was moreover contended that with a less rigid specification and the use of half-round sleepers, a greater number of sleepers could be provided at a reduced price. No final decision, as far as that particular point is concerned, has, it is believed, been arrived at, and in the meantime it is interesting to read what a correspondent of *The Times Trade and Engineering Supplement* has to say on the experiments now being made with metal sleepers on British railways.

Sleepers of an inverted trough form, made of cast-iron, wrought-iron or, more usually, steel, have been in use in many countries, including India, for a good many years. They were not, however, widely adopted, taking the world's track mileage into account, as they were liable to deteriorate through corrosion and had to be packed with care and with ballast of a suitable kind. In British practice, the chaired bull-headed rail has long been preferred to the flat-bottomed type, and it has recently been sought to devise a steel sleeper better suited to the former than any which had previously obtained. To that end, two improved forms have been brought forward, one the invention of Mr. C. P Sandberg, and the other a production of Messrs. Guest, Kem and Nettlefolds, known as the "G. K. N." Both are of steel, and adapted for employment with bull-headed rails.

In the Sandberg sleeper, "each chair portion is pressed out so as to form two supporting jaws, which are integral parts of the sleeper itself. The inner jaw is in contact with the web of the rail, the outer jaw being left open for the insertion of a specially shaped wooden key. Beneath the chair is a base-plate of pressed steel, recessed to hold the rail and to give it the usual inward inclination of 1 in 20 to the vertical, the arrangement being such that when the key is driven home both the rail and the base-plate are securely fastened to the sleeper." The "G. K. N." sleepers have the chairs cast directly on them. "Four holes are punched in the ends of each sleeper to take four snugs formed on the underside of each chair. By means of these snugs, the chairs are fixed in position, and the need for bolts, as with the Sandberg sleeper, is avoided. The chair seats are sloped to give the rails the necessary tilt at 1 in 20, and the outer jaws of the chairs have tooth-like grooves to hold the customary wooden keys firmly in place." Both the types are now under trial on railways, and it is understood that so far there has been no final decision regarding them. The issue is of some importance to England, as if metal sleepers as efficient and as economical as the wooden can be manufactured in the country, it will save importation and be of assistance in the present grave situation of unemployment. In India the question has another complexion, and if the indigenous wooden sleeper is to compete successfully with the metal sleeper, it has to be shown that it is able to do so at no greater cost. For it is not the Forest Department alone that is concerned, there is the Railway Department as well, and in these days of financial stringency and deficits the Railway Board cannot well afford to neglect economical considerations.

(Indian Engineering.)

MEASURING STANDING TIMBER.

HOW IT MAY BE DONE ON THE BASAL AREA SYSTEM.

By Leslie S. Wood, F.S.I., of East Grinstead.

It would be of interest to know how timber merchants and valuers, as a rule, measure up an area of woodland, and more particularly an area of mixed timber. Some men undoubtedly rely on their judgment, but however clever one may be there is no question that it is dangerous to rely on our judgment unless we can buy or sell at a figure which allows for a large margin of error. There are occasions when a rough estimate is sufficient for a special purpose, but even then the wise men will take the average of several estimates rather than rely on his experience for one general figure. The more cautious man will, perhaps, judge the distance apart of the trees and estimate the average size of a tree, so arriving at the number of cubic feet per acre and, ultimately, the total cubic contents; but if he has to value 60 acres of mixed wood of varying characters and sizes he finds it very difficult to divide the classes and to price the timber, such a method being nothing more than a check on his judgment.

There are those who measure from tree to tree, but it is a slow method, and those who have had to measure a large area and have laboriously moved from tree to tree for several days must often wish there were some easier way of getting an accurate result. In the case of pure woods, such as larch or Scots fir, or with the beech on the Chiltern Hills, some valuers take sample areas of about a quarter of an acre and on them measure the timber accurately, so getting at the total cubic contents; but it is always difficult to judge the average places for taking sample areas, and at all times it is difficult to arrive at a proper allowance for rides and boundaries and the inferior timber on the sides exposed to the prevailing winds.

An accurate calculation is advisable, not only for the purpose of arriving at a proper value, but also for the purpose of knowing what timber is really available and for estimating the strength required to tackle the job and the time to be allowed for removal. It will, therefore, be realised that if it be possible to have a system of measurement which will give a classification of the timber and at the same time an accurate calculation of the cubic contents of each class, and do the whole thing in about one-sixth of the time occupied by a tree-to-tree measurement, it is a system worth consideration. Such a method is the basal area system, which I will describe, and no one who has ever adopted it would ever think of going back to the old system of poling and strapping from tree to tree.

The immediate criticism is, of course, that it is all theory; but the ready answer to that is that every timber merchant and valuer can easily check the system before he adopts it and may compare the result with the figures obtained from a tree-to-tree measurement. He may not at first feel confident in a system which is partly mechanical, but the rule is so very accurate that if it be applied to several cases, always proving itself to be correct, any doubt very soon disappears.

In order to describe the system as simply as possible it is well to take as an example an area of one sort of timber only. Briefly the system is as follows:

(1) Every tree is girthed at breast height and the recorder puts down the tree in his book under its quarter-girth class, the total number of trees in each class being thus obtained.

(2) By means of Hoppus, the total area of a section of every class at breast height is obtained. This gives the basal area of each class, and the total basal area is also obtained.

(3) By dividing the total basal area by the number of trees the basal area of an average tree is found.

(4) By means of Hoppus the quarter-girth of the average tree is obtained.

(5) A certain number of trees of the average quarter-girth are then measured accurately to give the cubic contents of an average tree.

(6) The average contents multiplied by the number of trees give the total cubic contents.

This appears to be a little complicated, but is not so in practice, and the calculation from Hoppus for finding the average tree in a 30-acre wood can be made in 20 minutes. In order to illustrate the system we will deal with it under its separate headings:

I.—MEASURING AND RECORDING.—It is usual to have two or three men or boys to strap and call out the quarter-girth measurements of the trees and scratch them as they go. The recorder will put down the trees in his book in series of fives or tens, and in the end the totals will perhaps show a result as in the second column, with a total number of trees of 652.

Quarter-girth at breast height.		No. of trees.		Basal areas. Ft.	Ins.	Pts.
9	...	5	...	2	9	9
9½	...	12	...	7	6	3
10	...	18	...	12	6	0
10½	..	32	...	21	6	0
11	...	58	...	48	8	10
11½	...	65	...	58	8	4
12	...	79	..	79	0	0
12½	..	82	...	88	11	8
13	...	71	...	83	3	11
13½	...	62	...	78	5	8
14	...	53	...	72	1	8
14½	...	41	...	59	10	4
15	...	33	...	51	6	9
15½	...	18	...	30	0	4
16	...	11	...	19	6	8
16½	...	7	...	13	2	9
17	...	—	...	—	—	—
17½	...	4	...	8	6	1
18	...	1	...	2	3	0
		652	...	741	7	10

II.—CALCULATING THE BASAL AREA:—Now most people have been accustomed to regard Hoppus merely as a means of finding the cubic contents of a tree when the quarter-girth in the centre and the heights are given; but it is something much more than this, and if we take the first column in Hoppus to represent the number of trees in every class we find that the second column represents the area of the section at the point of measurement—that is to say, the basal area. Thus, if we turn to the 12in. table and regard the first column as the number of trees, we find that one tree gives 1 sq. ft., two trees 2 sq. ft. and so on. So, also, if we turn to the 8in. quarter-girth we find that nine trees give 4 sq.ft., and mathematically this is $\frac{8}{12} \times \frac{8}{12} \times 9$. However complicated the figures, the rule always applies.

So in the example given, if we turn to Hoppus we find that five trees with a quarter-girth of 9in. give a basal area of 2ft. 9in. 9pts., 12 trees of 9½in. give 7ft. 6in. 3pts., and so on. Thus we got the extension shown in the third column of the example, and the total basal area is 742ft. 7in. 10pts.

III.—TO FIND THE AVERAGE TREE.—We now divide the total basal area of 742ft. 7in. 10pts., by the number of trees, 652, and this shows the basal area of the average tree to be 1ft. 1in. 8pts.

IV.—TO FIND THE AVERAGE QUARTER-GIRTH.—Now turn to Hoppus and find the quarter-girth of the tree which will give a basal area of 1ft. 1in. 8pts. We find that one tree of 12¾in. gives 1ft. 1in. 6 pts., and one tree of 13in. give 1ft. 2in. 1pt., so the nearer is 12¾in., which is the girth of the average tree of the 652 measured.

V.—TO FIND THE CUBIC CONTENTS OF THE AVERAGE TREE.—It is now necessary to walk through the wood systematically from one corner to the other and measure with strap and pole some 20 or 25 trees of a girth of 12¾in. at breast height. It may be difficult to find trees of that exact girth, so an equal number of 12½in. and 13in trees may be taken to give an average so far as 12¾in. trees or not found. The trees must not be selected in any way; they must just be taken as they come, good and bad, and should be scattered all through the wood, so as to give a true average. The total of 20 trees will, perhaps, be 720 cub. ft., giving an average tree of 36 cub. ft.

VI.—TO FIND THE TOTAL CONTENTS.—There are 652 trees and the average size over-bark is 36 cub ft., so the total number of cubic feet is 562 by 36=23,472 cub. ft. From this the bark allowance, if any, can be deducted to get at the net contents, and the value can be calculated accordingly.

It will be seen that there are several advantages attaching to this system, and they may be summarised as follows:

(*a*) The system is very accurate, and it is made more so by the fact that the valuer only has to measure trees of an average size; in this case those of 12½in. and 13in quarter-girth.

(*b*) It is a quick method. With three men measuring it is possible to cover 20 or 30 acres in a day of normal timber, and with small larch 1,000 trees can be measured in an hour.

(c) A complete schedule of the timber is obtained. The advantage of this is found not only in the selection of trees, but any timber of a certain quarter-girth can be taken out and it is still possible to find the average tree and recalculate the cubic contents.

(d) It does not require the services of a skilled valuer until the last stage is reached. The calculation of the average tree is a mathematical process, calling for no skill, so that any efficient assistant can do all that is necessary up to the point of selection and measurement of the sample trees. In the illustration given the valuer would be told that the average tree was 12⅞in. and within an hour he would measure up the 20 or 25 trees, value them and finish the work.

(e) It is a very great advantage in dealing with a mixed wood because the whole of the timber is classified. In such a case the measurers call out the sort of tree, as well as the quarter-girth, and the recorder enters every tree under its appropriate class and size. The average tree of each sort is then calculated and sample trees are measured.

It may be said that it is quite unnecessary to go to all this trouble in finding the basal area in order to calculate the average tree, that it would be just as simple to take an average of the quarter-girths and that if a sufficient number were taken it would be just as accurate. But that is not so, and the error can easily be demonstrated by taking six trees under both systems, all of them 30ft. long, supposing the quarter-girths in the centre were 6in., 8in., 10in., 12in., 14in., and 16in. Cubic contents:

1	30	6″	...	...	7	6	0
2	30	8″	...	...	13	4	0
3	30	10″	...	...	20	10	0
4	30	12″	...	...	30	0	0
5	30	14″	...	...	40	10	0
6	30	16″	...	...	53	4	0
					165	10	0

The average of the girth is 11in. and the total length is 180ft.; this would only give contents of 151 cub. ft., which is an error of about 9 per cent. On the other hand, the basal area would show:

1	1 tree at	6″		...	...	0	3	0
2	1 ,,	8″	...	...	...	0	5	4
3	1 ,,	10″	...	...	...	0	8	4
4	1 ,,	12″	...	...	...	1	0	0
5	1 ,,	14″	...	...	...	1	4	4
6	1 ,,	16″	...	...	...	1	9	4
						5	6	4

The average of the six trees would be 11in. 1 pt., so the average tree would be 11¼in. quarter-girth and 180ft. of 11¼in. quarter gives 165 cub. ft.

It has been said that the efficiency of the system can very easily be checked, and this is so. If in the course of a day's measuring the quarter-girth of every tree when strapped is noted, the trees can then be classified and the quarter-girth of the average tree calculated. Suppose the average tree is 15in. Then, if the contents of all the 15in. trees be noted, the average cubic contents calculated and the result multiplied by the number of trees, the result will be practically the same as the total contents shown by tree-to-tree measurement.

Sometimes time is valuable and it is convenient to avoid the calculation of the sample tree through the basal area. In such a case, in nine cases out of ten the rule known as "Weise's rule" will be found accurate. Under this rule 40 per cent. of the total number of trees should be taken and, having this figure, the average tree will be found by counting back from the highest class until it is found in which class the figure will come. Thus, in the example before us, the total number of trees is 652. If we take 40 per cent. of this we get 260. If we now count back from the highest, that is the 18in. class, we find that the total number of trees down to and including 13½in. is 230, and including 13in. it would be 301. So the figure 260 comes into the 13in. class, which is, by this rule, the average tree. We know, as a matter of fact, the average tree is 12⅞in.

(*Timber Trades Journal.*)

SAFE WORKING STRESSES FOR INDIAN TIMBERS.

By L. N. Seaman, M.A., B.Sc., M.E.I.C.,

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Data so far Collected.

The necessity for reliable data on the strengths of Indian timbers has long been felt, and work on the systematic collection of such data has been in progress since 1921. Prior to that time some strength testing in wood had been done by Prof. Everett, Prof. James, Mr. R. S. Pearson and others, who have contributed valuable results, but it was not until the establishment of the Timber Testing Laboratory at Dehra Dun that standard methods were introduced into this country and our timbers tested in such a way as to permit their direct comparison with foreign species.

The collection of authoritative data on timber strengths is a slow process. Wood varies widely in its characteristics and a great many tests on each species are required. Strengths are influenced by condition of seasoning, locality of growth, and many other factors. Moreover, in the interests of economy, it is imperative to derive from any series of tests all the data that may be obtainable in regard to the utilization of the wood to avoid duplication of work later on. For these reasons the work is still in its early stages, but it is felt that enough data on strength

alone have now been collected to make it advisable to give to the public a very brief and incomplete table of working stresses. Though brief and incomplete, this table will be useful in engineering and architectural design, and can safely be taken as authoritative as far as it goes.

Selection of Suitable Species.

It should not be supposed, because a species of wood is found in a table of safe working stresses, that it is necessarily suitable for use as a structural timber. It is well to know the strength of wood for many applications other than building, and consequently the table with this note contains data on species which are not suitable for large construction. You would not ordinarily use wrought iron for jewellery nor gold and silver for nails. The same care should be exercised in choosing wood for use. Timber should be selected according to its suitability for the work in view, and then designed according to the figures found in the accompanying table.

Seasoning.

The timber selected should, as far as possible, be properly seasoned before it is used. Green or wet wood, exposed to the atmosphere, gives up its moisture until it reaches a state of equilibrium with the surrounding air. Thereafter it maintains that state of equilibrium. If the air grows damper the wood takes up more moisture, and *vice versa*. Logs and large squares, however, cannot be expected to dry in a short time, and the wood should be converted into beams, scantlings, boards, or half wroughts before thorough seasoning is attempted.

It has already been said that the wood takes up or gives off moisture to keep in equilibrium with the atmosphere. This cannot be prevented by ordinary means. Paint, varnish, polish, or other wood finish will retard the movement of the moisture, but nothing short of a complete coating of impervious material, such as aluminium leaf, will reduce it to a negligible amount.

This change of moisture in the wood causes shrinkage and swelling. You cannot prevent it. You might as well try to hang jelly on a nail as to stop wood swelling in the monsoon and shrinking in the dry season. Fortunately, however, the difficulty can be overcome by designing all wood-work to allow for the moisture changes. Panels securely fastened at both edges will bulge in the rains and split in the dry weather, but panels properly designed and constructed will remain satisfactory for years, even for generations. You cannot fasten wood to overcome the laws of nature, but you can design your wood-work to conform to those laws without damage.

Durability.

Sound wood, properly seasoned, will not decay unless again exposed to moisture. In the climate of India, however, it is again exposed to moisture in every monsoon, and this gives an advantage to the naturally durable species. Sound dry wood, moreover, may be attacked by insects. It is

possible, however, to protect even the non-durable woods against both decay and insect damage by preservative treatment. The kind of treatment will depend on the species of wood and on the use to which it is to be put, and each case should be decided on its merits.

LIMITATIONS OF THE DATA ACCOMPANYING THIS NOTE.

The table of safe working stresses now published is not supposed to be exhaustive, nor is it meant to be in its final form. At the present time, it is desirable to present these data in the simplest form possible. They are accurate and authoritative and can safely be used in design with reasonably sound timber, moderately straight grained, and having no knots larger than a fifth of the width of the face of the wood in which they are found. As research at this Institute progresses it is expected that grading rules can be prepared for various species. The use of such rules will make it safe to employ smaller sizes. With more data higher working stresses can be recommended for use with timber employed inside buildings and in other dry locations. Other economies can be effected by the more technical application of the results obtained in the Laboratory. For the present the accompanying table is published to make available the results of work now finished instead of delaying its release till it will be possible to give full data and final details of the most economical way to use all the Indian timbers. The completion of this work will require many years.

POSSIBLE FUTURE PUBLICATIONS.

At the present time tests are in progress at Dehra Dun and data are being accumulated which can be used to prepare tables of safe loads for beams of various spans with different species under given conditions, tables for use in the design of timber columns, and other aids in the use of Indian timbers for construction and for other purposes. Tables of actual strength test results will be published, and lists will be prepared to express the strengths of various species in terms of the strength of some well-known standard species such as teak. These are only a few of the advantages to be derived from the work of the Laboratory.

INFORMATION NOW AVAILABLE.

The figures presented in the accompanying table of safe working stresses have been compiled from the results of over 84,000 strength tests performed under a single line of investigation. A great deal of other information has already been accumulated under this and under other studies in progress at Dehra Dun. This information, though much of it is not yet ready for publication, is available for the public in reply to enquiries. Questions of the selection of suitable timber for given purposes, of seasoning, durability of wood, design or strength, if addressed to the Forest Research Institute, will receive the attention of men who have made a life study of the application of Forest Products in the most efficient and economical way to the needs of commerce and industry.

WORKING STRESS TABLE.

Serial No.	Species.	Trade Name.	Modulus of Elasticity, 1,000 lbs. per sq. in.	Transverse Strength, lbs. per sq. in.	Shear, lbs. per sq. in.	End Compression, lbs. per sq. in.	Side Compression, lbs. per sq. in.	Weight, lbs. per cu. ft. at 12% Moist. Content.
1	2	3	4*	5	6†	7	8	9
1	Abies pindrow	Himalayan Silver Fir ...	1,451	1,110	80	820	250	33
2	Acacia arabica...	Babul	1,541	1,870	200	1,430	720	52
3	Acrocarpus fraxinifolius ...	Mundani	1,791	1,640	160	1,330	505	42
4	Adina cordifolia	Haldu	1,215	1,350	125	1,090	480	41
5	Aegle marmelos	Bel	1,253	1,370	180	1,110	750	56
6	Albizzia lebbek	Kokko	1,589	1,370	140	1,130	490	40
7	Albizzia procera	White Siris... ...	1,283	1,360	125	1,080	475	41
8	Alstonia scholaris	Shaitan Wood ...	897	730	70	620	145	26
9	Anogeissus acuminata	Yon	1,914	1,880	155	1,460	590	55
10	Anogeissus latifolia	Axle-Wood	1,737	1,820	155	1,270	700	60
11	Artocarpus chaplasha	Chaplash	1,296	1,340	110	1,070	400	...
12	Artocarpus hirsuta	Aini	1,487	1,530	95	1,310	365	37
13	Berrya ammonilla	Trincomalee Wood ...	1,901	1,920	145	1,420	605	60
14	Bischofia javanica	Bishop Wood ..	1,257	1,000	100	750	400	48
15	Bombax insigne	Didu	875	730	55	550	145	23
16	Bombax malabaricum	Semul	726	780	65	570	165	23
17	Boswellia serrata	Salai	1,026	960	95	700	230	33
18	Calophyllum elatum	Poon	1,454	1,350	120	1,140	315	38
19	Calophyllum tomentosum ...	Poon	1,390	1,370	100	1,090	315	41
20	Calophyllum wightianum ...	Poon	1,234	1,370	125	1,100	440	43
21	Canarium euphyllum	White Dhup... ...	1,142	730	70	530	135	26
22	Casuarina equisetifolia	Australian Beefwood ...	1,628	1,490	165	1,030	440	...
23	Cedrela serrata	Toon	1,248	1,180	100	950	320	35

24	Cedrela toona	Toon	910	890	90	680	260	30
25	Cedrus deodara	Deodar	1,348	1,240	90	990	295	35
26	Chickrassia tabularis	Chickrassy	1,192	1,200	135	900	435	42
27	Chloroxylon swietenia	East Indian Satinwood...	1,663	1,850	180	1,380	700	...
28	Cryptomeria japonica	Dhupi	301	390	65	300	95	16
29	Cullenia excelsa	Karani	1,768	1,500	80	1,140	295	39
30	Dalbergia latifolia	Indian Rosewood ...	1,193	1,310	140	1,010	465	55
31	Dalbergia sissoo	Sissoo	1,264	1,460	140	1,110	425	50
32	Dichopsis elliptica	Pali	1,687	1,420	95	1,070	320	38
33	Dillenia indica	Chalta	1,225	1,220	105	920	300	40
34	Dillenia pentagyna	Dillenia	1,076	1,200	120	900	385	39
35	Diospyros melanoxylon ...	Ebony	1,094	1,110	110	890	365	47
36	Dipterocarpus alatus	Gurjun	1,478	1,340	100	1,110	340	42
37	Dipterocarpus griffithii	Gurjun	1,866	1,500	115	1,130	325	48
38	Dipterocarpus kerrii	... ...	1,937	1,450	120	1,030	280	49
39	Dipterocarpus macrocarpus ...	Hollong	1,898	1,470	95	1,120	385	45
40	Dipterocarpus tuberculatus ...	Eng, in	1,754	1,660	125	1,250	540	53
41	Dipterocarpus turbinatus	Gurjun	2,020	1,570	95	1,300	420	48
42	Duabanga sonneratioides ...	Lampatti	1,192	1,000	75	810	200	30
43	Dysoxylum malabaricum ...	White Cedar ...	1,553	1,340	130	1,010	340	46
44	Eugenia gardneri	Jaman	1,698	1,500	145	1,160	640	59
45	Eugenia Jambolana	Jaman	1,556	1,620	155	1,230	520	48
46	Garuga pinnata	Garuga	1,078	1,190	130	910	370	36
47	Grewia tiliaefolia	Dhaman	2,108	1,860	170	1,520	660	49
48	Hardwickia binata	Anjan	946	1,440	165	1,130	820	53
49	Heritiera minor	Sundri	1,960	1,670	160	1,270	880	65
50	Heterophragma adenophyllum ...	Karen Wood ...	1,880	2,050	145	1,890	815	53
51	Holoptelea integrifolia	Indian Elm	1,061	1,220	115	850	305	37
52	Homalium tomentosum	Burma Lancewood ...	1,893	1,880	170	1,530	630	58
53	Hopea glabra	Kong	2,104	2,170	200	1,840	1,095	67
54	Hopea odorata	Thingan	1,513	1,640	120	1,390	675	46
55	Hopea parviflora	Hopea	1,853	1,890	165	1,670	1,045	58

* Value given in the table is for use with structures subject to intermittent loading. For dead loads and for loads of long duration use one-half the value given.

† The values given in the table are of calculating "Horizontal Shear" in beams. For other purposes such as shear in joints the value given should be multiplied by 10/7.

WORKING STRESS TABLE—*Concld.*

Serial No.	Species.	Trade Name.	Modulus of Elasticity, 1,000 lbs. per sq. in.	Transverse Strength, lbs. per sq. in.	Shear, lbs. per sq. in.	End Compression, lbs. per sq. in.	Side Compression, lbs. per sq. in.	Weight, lbs. per cu. ft. at 12% Moist. Content.
1	2	3	4*	5	6†	7	8	9
56	Hymenodictyon excelsum ...	Kuthan	914	800	90	600	205	31
57	Lagerstroemia flos-reginae ..	Jarul	1,285	1,230	110	950	545	40
58	Lagerstroemia parviflora ...	Lendi	1,561	1,450	140	1,100	415	46
59	Lagerstroemia tomentosa ...	Leza	1,650	1,450	145	1,150	440	41
60	Lannea grandis (Odina wodier) ...	Wodier	801	870	80	620	245	35
61	Machilus spp	Ladder Wood ...	1,422	1,260	135	1,040	390	43
62	Mangifera indica	Mango	1,298	1,240	125	930	340	41
63	Melanorrhoea usitata	Thitsi	1,382	1,230	125	1,180	745	53
64	Mesua ferrea	Mesua	2,319	2,370	160	1,960	650	60
65	Michelia cathcartii	... ...	1,473	1,060	100	790	210	33
66	Michelia champaca	Champak	1,194	1,140	95	890	280	31
67	Michelia excelsa	...	1,439	1,100	75	850	240	32
68	Morus alba	Mulberry	1,266	1.470	165	1,090	580	42
69	Ougeinia dalbergioides	Sandan	1,215	1,350	155	1,070	560	...
70	Parashorea stellata	Tavoy Wood... ...	1,915	1,460	105	1,220	410	45
71	Parishia insignis	Red Dhup	1,118	730	80	540	130	30
72	Pentacme suavis	Burma Sal	2,012	1,830	140	1,520	990	57
73	Phoebe hainesiana	Bonsum	1,351	1,340	110	1,100	305	35
74	Picea morinda	Himalayan Spruce ...	1,244	900	65	650	200	29
75	Pinus excelsa	Blue Pine	967	820	75	660	185	32
76	Pinus longifolia	Chir	1,388	1,000	85	810	270	38
77	Planchonia andamanica	Red Bombway ...	1,864	1,640	125	1,370	545	57
78	Polyalthia fragrans	...	1,308	1,100	90	890	190	32

79	Pterocarpus dalbergioides ...	Andaman Padauk ..	1,599	1,740	130	1,520	610	45
80	Pterocarpus macrocarpus ...	Burma Padauk ...	1,897	2,280	175	1,820	880	54
81	Pterocarpus marsupium	Bijasal	1,458	1,510	120	1,160	450	50
82	Sageraea elliptica	Chooi	2,134	2,180	135	1,590	585	51
83	Schima wallichii	Needle Wood ...	1,361	1,130	115	840	250	43
84	Schleichera trijuga	Kusum	2,317	2,290	210	1,920	940	68
85	Shorea assamica	Makai	1,319	1,130	115	900	315	34
86	Shorea obtusa	Burma Sal	2,339	2,040	170	1,830	1,175	65
87	Shorea robusta	Sal	2,135	1,990	130	1,560	660	56
88	Sonneratia apetala	Keowra	1,228	1,300	120	940	525	39
89	Stephegyne diversifolia	Binga	1,330	1,500	125	1,170	440	41
90	Stephegyne parvifolia	Kaim	1,112	1,280	135	1,000	410	39
91	Swintonia floribunda	Taung Thayet ...	1,638	1,230	120	910	250	40
92	Tectona grandis	Teak	1,600	1,590	115	1,240	465	42
93	Terminalia arjuna	Arjun	1,097	1,240	145	940	580	50
94	Terminalia belerica	Bahera	1,838	1,580	120	1,320	385	50
95	Terminalia bialata	White Chuglam ...	1,761	1,580	115	1,240	395	43
96	Terminalia manii	Black Chuglam ...	1,801	1,700	145	1,310	565	52
97	Terminalia paniculata	Kindal	1,504	1,330	120	1,090	400	48
98	Terminalia procera	White Bombway ...	1,279	1,200	115	920	335	39
99	Terminalia pyrifolia	Lein	1,730	1,390	120	1,060	320	46
100	Terminalia tomentosa	Laurel	1,499	1,530	145	1,190	690	56
101	Vateria indica	Vellapiney	1,558	1,160	95	950	250	36
102	Xylia dolabriformis	Pyinkado	2,265	2,220	175	1,780	755	57
103	Xylia xylocarpa	Irul	1,655	1,650	165	1,380	860	52

* Value given in the table is for use with structures subject to intermittent loading. For dead loads and for loads of long duration use one-half the value given.

† The values given in the table are of calculating "Horizontal Shear" in beams. For other purposes such as shear in joints the value given should be multiplied by 10/7.

DOMESTIC OCCURRENCES.

FRY.—On October 30, 1931, suddenly, whilst playing golf, THOMAS BURGESS FRY, Indian Forest Service (retired), aged 81.

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NOTE ON DYING OFF OF GMELINA ARBOREA IN PLANTATIONS.

BY H.G. CHAMPION, I.F.S., SILVICULTURIST.

The following note is not intended to be a general dissertation on the subject of the title, nor a detailed investigation of a specific example, nor even a pessimistic prophecy: it is the record of an unexpected happening written with the object of inviting attention to the many *Gmelina* plantations scattered over India and Burma with a view to obtaining additional records, if the phenomenon is occurring elsewhere, and to eliciting possible explanations. It is urged that those who can supply such records or suggestions will do so.

At the Research Institute, we have plantations of *Gmelina* of various ages from about 19 years downwards, in blocks varying from 2 or 3 lines of plants to several acres. In the new experimental garden, which was under irrigated wheat and rice till 1926, we have a series of strips, from seed, transplants and stumps, 3-10 plants wide, with about 100 plants down the lines, and growth has generally been very satisfactory. The seed used has been of various origins, local, Chittagong, Burma, etc., and the strips are separated by a varying number of similar strips of other species.

In 1930, the writer pointed out to several visitors the relatively late leafing of the oldest strip, planted in 1927, as compared

with the next lot which is a year younger, and it was suggested that it might be connected with different seed origin. As time passed, however, it became evident that there was something wrong: not only was the leafing three or four weeks late, but it was generally poor, the leaves being only about half sized and internodal extention almost nil. Such leafage as was developed turned colour and fell in August, and the twigs began to dry back, whilst coppice and low epicormic shoots were developed on the lower parts of the stems. At the end of the rains, the whole block of 500 plants, with but two or three partial exceptions, was leafless, but the stems were still green and most of them had the regrowth mentioned one or two feet high and quite normal in appearance. In alternate sets of 10, the old stems were cut back to watch development and compare it with that from stems left standing. A deep pit was dug alongside part of the line to see if any causative soil factor could be traced, but in vain: the soil is a rich loamy alluvium with occasional boulders and though some fairly compact gravel was found at about 6′, the roots, which appeared perfectly normal, were seen to have penetrated it without apparent difficulty. There were no indications of faulty drainage and the plants at one end of the line at least were well drained by a deep surface drain close by. Meanwhile the development of all the other younger strips was observed to be quite normal, well up to average or even exceeding it.

In 1931, however, the 1928 strip serving the previous season as a contrast to that the history of which has been described, behaved in exactly the same way, as also another strip of the same age, though an intervening strip sown during the year had grown well with only a local trace of the trouble. In this last strip, aged 3 seasons, the plants at one end (adjoining the drain mentioned above) showed a few plants with some dry twigs, short internodes and undersized leaves which point strongly towards the likelihood that next season we shall lose this strip also.

Examination of the neighbouring older and more extensive plantations showed no loss in the small 1916 plantation at Kaunli (half a mile away), though this has been badly infested with *Loranthus*, but scattered trees and quite small patches were affected

almost throughout the New Forest plantations of 1926—28, apparently all for the first time during 1931. What will happen in 1932 is still on the knees of the gods.

The coppice shoots of the plants affected in 1930 have developed very little during 1931, the cutting back making no difference, and many of the shoots being now affected.

In the experimental garden, further pits have been dug with the same negative results and it seems almost impossible to ascribe the dying off to soil conditions. If, indeed, unsuitable soil is the cause of the trouble, the reaction must be highly specific as one of the affected *Gmelina* strips has on one side of it, at 4′ intervals, lines of teak, *Phyllanthus* and *Alstonia*, and similarly on the other side, lines of *Acacia catechu*, and *Acer oblongum*, and none of these show any signs of the trouble—nor does any other of the many species under trial nearby including *Dalbergia sissoo*, *D. latifolia*, and *Adina*. Additional difficulties to a soil explanation are the apparent continued healthiness of the roots, and the simultaneous death of a whole strip at a time, despite the demonstrable variations in fertility, drainage, etc., and again the fact that apparently one and two season old plants are unaffected. No nursery stock has yet been found affected.

Looking for a climatological explanation, the last two years have not been exceptional either for drought or frost. It is true that a good deal of our *Gmelina* has been cut back once or twice by frost, but some of the affected lines have escaped frost damage, and regrowth after frost damage has been under observation yearly and is perfectly normal—usually the old stem dies right back to the ground and is replaced by a new coppice shoot from ground level, which in height attained by the end of the next growth season, falls somewhere between the original stem and the unaffected plants.

No fungus has been found in the roots, and on the stems none until they are quite dead when the usual saprophytes appear. There may be small lumpy excrescences at the scars of fallen leaves, but these appear to be merely an expression of arrested growth. No insect attack has occurred in the roots, or older

wood. The foliage is much riddled every year by a Chrysomelid beetle and its larva, *Calopepla layeana*, and the twigs are often gnawed by a weevil, *Alcides* sp., the larva of which also feeds in young twigs without affecting the general vitality of the plant. Both these insects, especially the former, attack only the larger plants, 5′ or more in height. The mortality thus cannot be ascribed to direct insect attack.

The remaining possibility would appear to be some bacterial or virus disease, but here again there are weighty objections to accepting this as the explanation. In a restricted area, how could a whole strip be virtually simultaneously affected whilst a nearby strip is untouched? Why should the younger stock escape completely? It might also be wondered whence a virus could suddenly have been introduced. It may be admitted that if there is any such virus, the *Calopepla* might well be the carrier as hardly a plant escapes its attentions.

A photo Plate 4 is given showing one of the affected strips of *Gmelina* and the healthy growth of the adjoining lines of other species.

THE SEEDS OF VATERIA INDICA LINN AS A SOURCE OF VEGETABLE TALLOW.

By S. V. Puntembaker and S. Krishna, Forest Research Institute, Dehra Dun.

Among the ingredients of the size paste used in yarn weaving, animal tallow is the most important of the softening substances by virtue of its emollient properties. It is primarily used to prevent the adhesives and weighting materials from becoming hard and also to preserve the soft and supple qualities of yarn. Its relatively high price has created a demand for cheaper substitutes, such as various oils and fats, which are employed either alone or in conjunction with tallow. But more frequently they are used as adulterants and sold under various trade names. Oils, as a rule, have not the same binding power as tallow and, that is worse, they impart to yarn a yellowish colour and a dull

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1928 plantation of *Gmelina arborea* from patch sowings as it appeared in November 1931.

Photo Har Swarup.

tone. Such adulterants have harmful effects on yarn and, therefore, frustrate the purpose of softening for which they are employed.

Animal tallow is imported into India in fairly large quantities and the following figures for imports of tallow and stearine show that these products have a steadily increasing demand in the Indian market. About 85 per cent. of the imports is consumed in the Bombay Presidency where most of the cloth mills are located.

Imports of Tallow and Stearine into India.

Year.	Quantities in cwt.	Cost in Rs.
1922-23	72,854	25,24,741
1923-24	74,623	25,71,272
1924-25	78,799	27,89,365
1925-26	85,411	29,39,970
1926-27	...	31,64,307
1927-28	...	26,25,100
1928-29	...	24,63,000
1929-30	...	31,02,000

(From Annual Statement of the Sea Borne Trade of British India, 1927, and the Indian Year Book, 1930).

With the expansion of the cotton weaving industry the demand for tallow is bound to increase, since this is the only right type of sizing material that can be suitably employed and no reliable substitute has yet been discovered. But in India the manufacturers as well as the buyers (especially the Hindus) have a strong religious sentiment attached against the use of animal tallow which is extracted from butchered carcases of sheep and oxen. To meet this objection various varieties of vegetable tallows have been introduced in the market, none of

which have given entire satisfaction and are comparable to animal tallow. The so-called vegetable tallows of the market are in most cases emulsion of soaps in oil or the animal tallow adulterated with oil and soap.* If, therefore, a true vegetable substitute could be found with all the essential properties it will certainly attract the attention of cloth mills and may develop into a rival industry to animal tallow. Our work on the solid fat from the seeds of *Vateria indica*, better known as piney tallow or vegetable butter, has brought us to the conclusion that this fat can form an admirable true vegetable substitute since it possesses properties both physical and chemical, akin to those of animal tallow. This is noticeable from the table given below :—

	Beef tallow† (Australian.)	Mutton tallow† (Australian.	Piney tallow (Indian.)
Melting point	43°-44°c	45°C	40°C
Iodine value	35·8	42·5	40
Solid acids (Palmitic and stearic)	55·5%	54·2%	53%
Liquid acids (oleic and linoleic)	44·5%	45·8%	47%

* Attempts have been made by several Indian individuals and firms to find a proper substitute for imported tallow for cotton-sizing purposes, and as a result some companies are manufacturing tallow substitutes. It has, however, been the opinion of some textile mills that tallow substitutes on the market at present are not very good, and so unless a satisfactory substitute is produced the mills will have to use imported tallow. The process used by those who are manufacturing a substitute at present consists in partially saponifying a thick viscous oil, such as castor oil, and thus turning it into a solid product more or less resembling the imported stuff in appearance. The main difficulty in the present tallow substitute is that manufacturers are not making a standard product capable of being used for all types of work". (News Edition Ind Eng. Chem. Vol. 9, No. 22, p. 336 (1931).

[† Fats Natural and Synthetic, by Myddleton and Barry (1924), pp. 91 and 111].

A good sizing tallow should possess the following specifications—(*a*) it should be quite fresh and pure, (*b*) it should have a good white tone, and (*c*) it should have a firm texture and melting point between 40°-50°C. Piney tallow can easily be obtained in fresh condition, has a white colour, imparts no stain to white cotton fabric and possesses a firm texture. In fact, it answers all the requirements enumerated above and, therefore, in the opinion of certain experts is admirably suited for yarn sizing.

Vateria indica or *dhupa* trees form evergreen forests at the foot of the Western Ghats from Kanara to Travancore, and in the Coorg Ghat Forests they are said to be the most plentiful of all the important species. The wood is regarded as a first class timber especially for tea chests and packing cases. The flowers appear from January to April and the fruits ripen from May to July (Manual of Indian Timbers, by Gamble). The kernel of the seeds are reported (Dictionary of Economic Products, by Watt, Vol. VI, part IV, p. 224) to yield about 50 per cent.* of a pale greenish yellow fat, which on standing is rapidly bleached by air, and of a consistency approaching that of the mutton tallow. The method of extraction is by boiling in water the powdered kernels and allowing the extract to cool, when the fat which is found to float on the water surface is skimmed off. Piney tallow is reported to have several uses of commercial interest, for instance, it is used as an adulterant for 'ghee', in candle making, and for certain medicinal purposes, especially as a local application in chronic rheumatism. Only recently it has attracted attention as a suitable fat for soap manufacture and a proposal to install an extraction plant for preparing the *dhupa* fat at Bangalore is under consideration. Piney tallow has so far not been employed as a substitute for animal tallow in sizing of cotton yarn, and its use as such appears to have been overlooked due to the mis-statement of its chemical composition by early workers. (G. Dal Sic, Gazz. Chim. Ital, VIII, 107.) Hitherto, it has been believed that the

* The yield of the fat obtained in our experiments is only 22 per cent. of the kernels and this value agrees with that obtained at the Imperial Institute, London. (Bull. Imp. Institute, 1930, p. 280.)

Vateria indica fat consisted of glycerides of palmitic and oleic acids, whereas our present work on the subject goes to prove that the fat consists mainly of glycerides of stearic and oleic acids.

By solvent extraction, the dried kernels yield about 22 per cent. of the fat, and only 13 per cent. by expression, under pressure, at 60°-70°c temp. The fat consists of glycerides of solid acids (53 per cent.) and liquid acids. The physical and chemical constants are recorded below :—

	Authors 1930.	Imperial Inst., London, 1930.	International Critical Tables, 1927.
Method of extraction ...	hot expression ...	solvent... ..	...
Consitency ..	fairly hard ...	fairly hard ..	...
Colour	pale yellow ...	greenish white ..	...
Melting point ...	40°c	34·2°c	35°c
Specific gravity ...	0·9120/20°	0·8585/100°c	0·915/15°c
Refractive Index ...	1·4556/25°c	1·4585/40°c	1·4575/40°c
Saponification value ...	190·4	190·3	188·7 to 192
Iodine value ...	40 (Hanus) ...	45·9 (wijs) ..	37·8 to 39·1
Acetyl value ...	2·45	...	...
Hehner value ...	97·6	...	95·1 to 95·2
Unsaponifiable matter...	c.8%	0·9%	...
Acid value ...	1·4	1·0	5·8 to 15·3

The seeds of *Vateria indica* are not exported in any large quantity and only small amounts are collected for local consumption. The figures that we have been able to obtain through the courtesy of the Forest Utilization Officer, Madras, show that in

1929-30 about 7,500 mds. of the seeds were collected by the contractors from the reserved forests and unreserved lands.* If the piney tallow is to find an extended application in the manner we have suggested, it is evident that much larger quantities of it will have to be collected. We have not been able to obtain figures to enable us to estimate the total quantities of the seed that are available in any year, but we take it that this cannot be large enough to supply the total quantity of vegetable tallow that would be needed to replace animal tallow. Need for exploring other sources of oils and fats of the type of piney tallow is, therefore, obvious. Two other such fats are the *kokum* butter (*Garcinia indica*) and the Chinese vegetable tallow (*Sapium sebiferum*), both of which are minor forest products of India and possess practically the same properties as the piney tallow and can be employed in sizing of cotton yarn. The following table shows the similarity of the chemical and physical constants of these fats :—

	Piney tallow.	Kokum butter.	Chinese vegetable tallow.
Specific gravity at 15°c	0 915	0·920	0 918
Melting point ...	40°c	41°—43°c	36°—46°c
Refractive Index ...	1·4556/25°c	1·4565/40°c	...
Saponification value ...	190·4	187—191	179—203
Hehner value ...	97·6	93—95	93
Iodine value ...	40	25—34	23—38

* "The seed of *Vateria indica* and the fat obtained from it are exported from South Canara and at present export is made chiefly of the seed. During the season 1929-30 and the following season 358 tons of the seed were reported to be shipped.

As regards the quantity of the stuff consumed locally no correct estimate can be made but a good deal of this is sold in the shape of balls, particularly in the villages where people collect the seeds and prepare the fat by boiling the crushed seed with water. The seeds yield about half their weight of fat." (Letter No. 1736-A/31 of the 12th December, 1931, from the Director of Industries, Madras, to the Fores Utilization Officer, Madras.)

Kokum tree (*Garcinia indica*) is found in the Ghats of the Konkan and Kanara, most commonly in Southern Konkan, and is considerably cultivated in gardens of that district. The fat is prepared especially on the West Coast, between Daman and Goa, in a primitive fashion by drying the seeds in the sun and boiling them out with water. The fat is then skimmed off, filtered and cast into cakes. *Kokum* butter is a white or light grey fat having a slight not disagreeable odour and a mild oily taste. The acid constituents of *kokum* butter are oleic and stearic acid. It is chiefly used as an edible fat and is stated to be employed for adulteration of ' ghee'. *Garcinia morella* and *G. pictoria* from the west districts of Mysore also give a fat similar to *kokum* butter.

Sapium sebiferum is the source of Chinese vegetable tallow. "The tree grows wild in China. Since it has been cultivated there it has been introduced into North of India where it grows luxuriantly, as also in the Punjab and the United Provinces. The tree commences to produce at the age of four to five years and when it has reached its full development it yields about 25—30 kilos of seeds a year. Hundred kilos of the fruit yield about 30 kilos of the fat. The production of vegetable tallow in China is very large and has been practised there for many centuries and about 10,000 tons of it is exported every year." (Chemical Technology and Analysis of Oils, Fats and Waxes, by Lewkowitsh, Vol. II, p. 592). In China this fat is used in place of animal tallow for the manufacture of candles, soap making and also in dressing cloth (Agr. Ledger 1904, p. 13).

The cost of extraction of fats from the above vegetable sources cannot be very heavy and, therefore, it appears possible to place on the market vegetable tallows at competitive prices. And in this connection we strongly recommend the study of the Note on the "Economic Value of the Chinese Tallow Tree", by Puran Singh, published in the "Indian Forester", 1918, p. 383.

A NOTE ON THE REGENERATION OF DEODAR IN THE UDIL RANGE, RAMBAN DIVISION, JAMMU, WITH SPECIAL REFERENCE TO THE ERADICATION OF POHU (PARROTIA JAQUEMONTIANA).

BY SHER SINGH, M.Sc., DEPUTY CONSERVATOR OF FORESTS.

In the October, 1931, issue of the *Indian Forester*, the progress of the Shelterwood System of working in the Lolab Range, Kashmir, has been reviewed, and it may be of interest to record its progress in the Udil Range, Ramban Forest Division, which has some of the very best deodar forests in the State, and for that matter in the Himalayas. It has been shown that in the Lolab the progress of this system is very satisfactory indeed, except in Compartment 25, Chandigam, the reason for which will be apparent from what follows. It was in this Compartment that the writer made his first working acquaintance with the *pohu* otherwise called *killar* (*Parrotia jacquemontiana*), a gregarious undershrub, which grows profusely in many of the deodar forests of Kashmir. The *pohu* is a splendid shade-bearer, resembling the European hazel, and forms a more or less uninterrupted underwood in wet deodar forests. In the Compartment referred to above, it formed a very dense interlaced thicket. So dark indeed was its cover that deodar seedlings growing under its shade had not been able to attain a height of even a foot in 20 to 30 years. This shows the baneful effect that *pohu* has on deodar regeneration and if it remains uncut for many years, the forest floor may become so wet and acid that either germination does not take place at all, or the seedlings succumb soon after germination. The cutting of *pohu* is not an easy operation as its wood is very hard and tough, and it reproduces itself rapidly from its fast growing coppice shoots. Indeed it has been observed that the *pohu*, like the proverbial Phoenix, regenerates itself in no time Foresters in the United Provinces and the Punjab may not be able to realise the seriousness of the situation as this weed is not so common in these Provinces, but the *pohu* is an aggressive weed in the deodar forests of Kashmir and it paves the way for regressive succession of deodar into fir or mixed fir forests. The success, or otherwise, of the Shelterwood System of working in

Kashmir, therefore, depends largely on the eradication of this pest. The first marking under the above system happened to be done in the above-mentioned Compartment which contained the darkest cover of *pohu*, and when the writer crossed the Pir Panjal, seven years back, to join his new duty in Ramban, the shadow of Chandigam lay dark over his heart.

The first markings under the Shelterwood System in the Jammu Province were done by the writer in Compartment 98 of Udil Range, in Sambat 1984 (1927-28). This Compartment resembled Chandigam of the Lolab in many ways, a mature deodar overwood; little or no regeneration, and abundant growth of the ubiquitous *pohu*. The *pohu* here was even more luxuriant than in Kashmir, as owing to a sparse population, it is rarely lopped, whereas in Chandigam and in other parts of Kashmir it is always shaggy due to repeated pruning. Moreover, owing to the monsoon, the Jammu deodar forests have more broad-leaved species than those in Kashmir. By way of comparison, it may be stated that while in Chandigam, Kashmir, the *pohu* is hardly thicker than a man's wrist, and about 5—8 ft. high, yet in Compartment 102 of Udil, Jammu, its girth varies from 6 in. to 26 in., the height being up to 20 ft. Compartment 98 Udil was not so bad as Compartment 102, Udil, but it was certainly worse than Compartment 25 of the Lolab (Chandigam). It will thus be seen that the Shelterwood System was put to a severer strain in the Jammu Province than even in Kashmir.

3. The first three years of working were rather indecisive, as two whole years were spent in clearing the coupe of the outturn, all of which was in the form of scantlings, and there was no deodar seed year. Last year, however, was a good seed year, and over 50 maunds of deodar seed were collected at Rs. 5 per maund, for the requirements of this Range. The following comparative methods of eradicating *pohu* were adopted, experimental plots covering several acres being laid down side by side:—

(*i*) Coppicing *pohu* at about 1′ from the ground-level and burning the cut piled branches.

(*ii*) Coppicing *pohu* at about 3′ from the ground-level and burning as above.

(*iii*) Coppicing *pohu* at the ground-level and burning the piled branches and slash on the stump of the cut *pohu*.

(*iv*) Burning *pohu* standing *i.e.*, without cutting, by piling slash and debris at its foot and burning the same.

The experiments made are already sufficiently conclusive and the following observations have been made. The first method of burning cut piled branches is not only laborious and costly, but practically useless in that the *pohu* puts forth abundant new shoots which soon cover the ground and smother deodar regeneration. The second method has been tried with some success in Kashmir, but does not seem to be very promising, for in addition to heavy cost, it gives a grotesque unkempt appearance to the coupe under working, and does not effectually prevent coppicing power of the *pohu*. The third method is better than the preceding two, but it is costly, and demands much labour which is rather sparse in the Jammu hills. The fourth method of burning *pohu* standing has yielded wonderful results and it is to this that attention is invited in what follows.

4. The technique of burning *pohu* standing is as follows :— As soon as the conversion is over and the P. B. I. coupe available for silvicultural operations, the slash and debris which occur in large quantity where all outturn is in the form of scantlings is collected round standing *pohu* shrubs. These heaps are about 1′—3′ high *i.e.*, proportionate to the girth of the *pohu*, and there are as many heaps as *pohu* plants. The heaps are burnt under proper supervision, and the burning embers are manipulated by wooden poles so that the fire may, as far as possible, burn round about the foot of the *pohu*. By so doing the collar and the foot of the *pohu* is charred and burnt, and the leaves shrivel up and die. It is found that this fire considerably reduces the coppicing power of the *pohu*, and if the burning is severe, the *pohu* will not coppice at all. The few coppice shoots that may come up are not nearly as active as the coppice shoots produced by the other methods nor

do they stand in the way of deodar regeneration. The secret of success lies in the severity of fire, which must be sufficiently intense to burn the collar and the adjoining parts of the *pohu* which have dormant buds. Furthermore, the time of burning *pohu* is very important, as burning in the rainy season is not so successful as burning in the autumn. The best results are obtained by late autumn burning, as then the sap is down, and severe burning is possible. Experiments were also made in winter, as then the sap is at its minimum, and although the results attained show marked dwindling in the coppicing power of *pohu*, yet as severe burning is not possible at that time on account of snow, hence late autumn is the best time for carrying out this operation. In the wet deodar forests, where *pohu* is abundant, there is not much fear of fire spreading, but even so strict supervision is necessary. These experiments, on a large scale, have now been carried out in Compartment 102, Udil, the lower portion of which was one seething mass of virgin *pohu*, the results of which operation will be available next year. But operations carried out in Compartments 98 and 20 are so satisfactory that these Compartments have now been more or less completely regenerated. The ash beds which were sown with deodar have yielded wonderful results as they are literally studded with established seedlings, some of which have reached the remarkable height of 15 inches, and one seedling is over 17½ inches in less than a year. This is, no doubt, due partly to active nitrification induced by the ground fire, as also to good quality of the soil enriched by the *pohu* litter, for in an adjoining nursery in the same Compartment the seedlings have attained a height growth of not more than 10 inches. This nursery alone contains about a lac of deodar seedlings, and the ash beds have several lacs of thriving deodar seedlings which will be available for transplanting next year. It has moreover been observed that the severer the fire passed over the forest floor, the more rapid the growth of deodar and the fewer the competing weeds which later on suppress deodar. It is hoped that these deodar seedlings are now out of harm's way even though the *pohu* may sprout a little here and there. Thus, by combining the process of slash disposal with the burning of

pohu standing, two birds have, as it were, been killed with one stone.

5. The reduction in cost in carrying out the silvicultural operations will be judged from the following extract from a recent tour note of Mr. H. L. Wright, I. F. S., Chief Conservator of Forests, Kashmir, who wrote as under regarding Compartment 98 :—"The cultural works in this Compartment are the most thorough that I have seen anywhere in the State, and, I believe, the cheapest. For in this Compartment of 840 acres, the total cost, including all cultural works, fencing and inspection road and a nursery, has amounted to only Rs. 2,356 or less than Rs. 3 per acre. Little more will be necessary in this Compartment for sometime except the tending and occasional weeding of the young crop, which is already well established both naturally and artificially." It is hoped that the above average will not be exceeded in Compartment 102 which has a heavy growth of *pohu*, but much depends on the Officer-in-Charge. The thanks of the Divisional Forest Officer are due to Pt. D. N. Koul, Assistant Conservator of Forests in charge of the operations, who with his zealous band of Assistants has considerably reduced costs and standardised technique.

6. The theory of the operation is simple. The *pohu* when it is coppiced keeps on putting forth new shoots as its root system, which is very elaborate, remains intact. By cutting the stem and burning the slash on the stump, the coppicing power is reduced partly but not wholly, for where the collar is dried, heat does not affect the hidden roots. By burning *pohu* standing, the desiccation is more thorough than otherwise, for at the time of burning, the crown continues to transpire, rather vigorously, and in so doing, it sucks the moisture from the roots, acting very much like a pump, which fire alone could not have done. The fire thus plays off the transpiring-crown against hidden roots, and in this mutual conflict both very often succumb.

7. It will be evident from the above brief sketch that the Uniform System of management is an unqualified success where the staff is sufficiently vigilant to make use of seed-years. Indeed,

it is the only system which offers possibilities of concentrated regeneration, and wherein results are open to evaluation and assessment. Under the Selection System which was practised hitherto the area was far too unwieldy to be effectively tackled by the forester, and more often than not, it was wholly ignored. If any comparison of the system is necessary, one has only to look to the Udil forests opposite Chhatru where heavy selection fellings, under the old plan, have resulted in utter degeneration of the deodar forests into sinister blanks full of broad-leaved shrubs, with no regeneration, whatsoever. The Uniform System takes a little at a time and keeps it on books until it has run the gauntlet. But one thing is necessary if success is intended to be achieved with the Shelterwood System; either the regeneration period should be sufficiently long to admit of natural regeneration, or the Officer-in-Charge must make the most of seed-years and raise a sufficient reserve in nurseries and ash-beds, from where to work at leisure in lean years, or better combine the above two processes of recuperation. Nature is very helpful but it works at a snail's pace, as it is in no hurry, but the forester cannot afford to wait too long; he must, therefore, have up his sleeve sufficient artificial stock to tide over recurrent depressions in deodar seed-years. This only stresses the importance of the personal equation, and subject to that proviso, the Uniform System is the system of quickly regenerating deodar. It is hardly necessary to state that sowing and burning of refuse is necessary only where natural regeneration is not likely to come up, not indiscriminately all over the forest. Generally speaking, the ridges, spurs and upper parts are best regenerated naturally, the foot of deodar forest where there is heavy admixture of *pohu* and other broad-leaved species being treated artificially.

8. One word more about *pohu*, the scarecrow of Kashmir deodar forests. The problem of successfully tackling *pohu* being within sight, the writer must make it clear that the *pohu* is not a 'weed' in the ignominious sense in which that word is often used. Indeed, it is often observed that the *pohu* goes with the very best deodar, being its indicator and helper, as the *pohu* rapidly enriches the soil by its abundant humus. As already mentioned, the

growth of deodar seedlings in the ash-beds under observation in Udil has been fastest and best where the *pohu* was heaviest. From this it is clear that the *pohu*, like fire, is a good servant but a bad master.

THE DURATION OF LIFE OF SOME INDIAN MAMMALS.

The duration of life among mammals is a subject of some interest in agriculture and forestry, but practically no information on it has been hitherto available. Major Stanley S. Flower has now concluded a series of "Contributions to our Knowledge of the Duration of Life in Vertebrate Animals" in the *Proceedings of the Zoological Society of London* with a discussion (1931, pp. 145—234) of the available information on mammals. From this splendid work, which is based on a large series of records of mammals in captivity in various parts of the world, the following information relating to Indian species has been abstracted by request. The names in brackets are those used by Blanford in his volume on mammals in the "Fauna of British India" series.

The Gibbons, *Hylobates hoolock*, *H. lar*, etc., reach maturity when about seven years old. "Instances of their living in captivity to nine years are rare, though they may live to the age of at least twenty-four years."

"The Old-World Monkeys, regardless of size, appear to have an average life of under seven years, a specific longevity of about ten years, a full-span life of about fifteen years, and a potential longevity of about twenty-five to thirty years." Langurs have lived in captivity in Calcutta for ten years, and a Nilgiri Langur survived for fifteen years in the Trivandrum Zoo.

Among the *Macacus* monkeys, the common *M. mulatta* (better known as *M. rhesus*) frequently lives to fifteen years and even more. There is a record of one individual that was probably twenty-nine years old at the time of its death. The Bonnet Monkey, *M. radiata* (*M. sinicus*) averaged a life of twelve years in the Trivandrum Zoo, and one individual lived to fifteen years. The Macaque or Kra Monkey, *M. irus* (*M. cynomolgus*)

lives for fifteen years, but individuals may live for almost twice this period. *M. silenus*, the so-called Wanderoo or Lion-tailed Monkey, only lives for five to ten years in captivity as a general rule. A slow Loris, *Nycticebus coucang*, has been recorded as living for ten years in the Calcutta Zoological Gardens.

Of the insectivores little is known. A Bornean Tree Shrew, *Tupaia tana*, has lived in the London Zoo for a little more than two years, and Hardwicke's Hedgehog, *Erinaceus collaris*, has survived in the same place for almost two and a half years. The average life of shrews and hedgehogs is probably in the neighbourhood of two years.

The Fruit-Bats have an average life of nine years with an extreme maximum of about twenty years. The common Flying Fox, *Pteropus giganteus* (*P. medius*), does well in captivity, a female having lived in London for over seventeen years and a male in Dublin for over eight years. Among the insectivorous bats Roux's Horseshoe Bat, *Rhinolophus rouxi*, seldom lives over four years and is not known to reach an age of five years.

Tigers, *Felix tigris*, may be expected to live in captivity for four or five years, but Flower has notes of fifty individuals with an average life of eleven years. Records of extreme longevity show that tigers can live for thirteen to nineteen years and probably more. Leopards, *Felis pardus*, appear to have a very similar span of life. Of the Snow-Leopard, *Felis uncia*, little is known, but it does not appear to have done well in captivity. One male lived in the London Zoo for a little over three years, and in Philadelphia a specimen died after nearly eight years of captivity. For other species of Felidae that occur in India the following records are available:—

Jungle Cat, *F. chaus*. Three specimens known that lived for a little more than nine years.

Lynx, *F. lynx*. One record (♀) of sixteen years life, and one (♀) of nearly eleven years.

Caracal, *F. caracal*. Seldom lives over seven or eight years in captivity. Individuals have, however, survived for as long as sixteen years.

Clouded Leopard, *F. nebulosa.* Difficult to keep alive in captivity. A female has, however, lived in the London Zoo for eight years.

Leopard Cat, *F. bengalensis*. One record of twelve or thirteen years life. A female is still alive in the London Zoo after some nine years there.

Golden Cat, *F. temminckii.* One record of life in captivity for nearly eleven years.

Fishing Cat, *F. viverrina.* Two records show that the average life is in the neighbourhood of ten years.

Cheeta, *Acionyx(=Cynaelurus) jubatus.* Seldom lives for more than six years in captivity. Records of extreme longevity show, however, that individuals may live for more than fifteen years.

For Indian Civets and Palm-Civets (Viverridae) the following records are known :—

Indian Civet Cat, *Viverra zibetha.* Five records of nine to fifteen years (average about twelve years).

Small Indian Civet or Rasse Civet-Cat, *V. malaccensis.* Between seven and eight years (two records).

Burmese Tiger Civet, *Prionodon maculosus.* One doubtful record of a specimen having lived for more than eighteen years.

Indian Palm-Civet, *Paradoxurus niger.* More than fourteen years (one record).

Malayan Palm Civet, *P. hermaphroditus.* Nearly twelve and a half years (one record).

Paradoxurus leucomystax. About thirteen years (two records).

Paradoxurus larvatus. Two records, showing a life of nearly eleven years and fifteen and a half years respectively, are available.

Small-toothed Palm Civet, *Arctogale leucotis.* Two records showing a life of eight years and eleven years respectively are given by Flower,

Bear Cat or Binturong, *Arctictis binturong*. A specimen was still living in the Trivandrum Zoo in 1913 after nearly twelve years there. Another died in London after being in captivity for eighteen years in Singapore and London.

Among the Mongooses, the common Indian Mongoose or Grey Mongoose, *Herpestes nyula* (also known as *H. griseus* and *H. mungo*) has an average life of two years in captivity, the records for extreme longevity being nearly five years (London) and eight years (Trivandrum). Other species of Indian Mongoose do better in captivity as the following records show:

Spotted or Small Indian Mongoose, *H. auropunctatus*. The average life is about seven years according to records from Calcutta and London.

Ruddy Mongoose, *H. smithii*. One specimen lived in the London Zoo for nearly six years.

Ceylon Brown Mongoose, *H. fulvescens*. One specimen lived in the London Zoo for nearly five and a half years.

Stripe-necked Mongoose, *H. vitticollis*. A male survived captivity in the Trivandrum Zoo for nearly thirteen years.

Of the Hyaenas, Major Flower writes: "The Striped, the Brown and the Spotted Hyaenas are all long-lived animals. Fifty-four individuals in fourteen different collections had an average life of twelve years and maximums of from twenty-three to twenty-five years." Eight records of the striped Hyaena, *Hyaena hyaena* (*H. striata*) range from nearly twelve years to twenty-four years, the majority being in the neighbourhood of sixteen years.

Regarding wolves, thirty specimens of *Canis lupus* averaged a life of nearly ten years, cases of extreme longevity being represented by two records of nearly fourteen years. Two Indian wolves, *C. pallipes*, are believed to have lived in captivity for nearly thirteen and fifteen years respectively. Jackals show an average and extreme length of life similar to that of wolves.

Specimens have lived for over twelve years in the Trivandrum Zoo and for over fifteen years in the Calcutta Zoo.

Several English specimens of the Common Fox, *Vulpes vulpes* (*V. alopex*) have lived in the London Zoo for more than eight years. Blanford, however, states that "Foxes live thirteen or fourteen years." An Indian Desert Fox, *V. leucopus*, lived in the London Zoo for nearly eleven years. Of the other Canidae little is known. An Indian Wild Dog, *Cuon dukhunensis*, was still alive in the Trivandrum Zoo after nine years, and a Malay Wild Dog, *Cuon rutilans*, survived captivity in the London Zoo for six and a half years.

Records of the Mustelidae are confined to Otters in so far as species occurring in India are concerned. Indian Otters have survived captivity for periods between eleven and sixteen years.

Bears live well in captivity. The average life of the Brown Bear, *Ursus arctos*, seems to be over twenty years, the extreme age not less than thirty-four years. The Himalayan Black Bear, *U. tibetanus* (*U. torquatus*), seems to have a very similar duration of life. The Malay Bear, *U. malayanus*, appears to be shorter lived, the average being under twelve and the extreme under twenty-one years. Several Sloth-Bears, *Melursus ursinus*, have lived in captivity for an average of twelve years and some for periods between sixteen and twenty-two years. According to Blanford a Sloth-Bear may live for forty years, but this is probably an over-estimate.

Among the Rodents, rats and mice have a specific longevity of two to three years and a potential longevity of five to seven years. Flying squirrels, squirrels, marmots and porcupines appear to have a specific longevity of five to ten years and a potential longevity of fifteen to twenty years. The following information relates to Indian species :—

Large Flying Squirrel, *Petaurista* (= *Pteromys*) *inornatus*. A specimen lived in the Calcutta Zoo for over eleven years.

Palm Squirrel, *Funambulus* (= *Sciurus*) *palmarum*. An albino specimen lived in the London Zoo for five and a half years.

Giant Squirrel, *Ratufa indica*. A specimen, in the possession of the Bombay Natural History Society, lived for over sixteen years.

Hodgson's Marmot, *Marmota* (= *Arctomys*) *caudata*. Three individuals lived to over six years in the London Zoo.

Black and Brown Rats, *Rattus rattus* and *R. norwegicus*. The average life of these rats is probably two to three years, but definite information is not available.

House Mouse, *Mus musculus*. Major Flower's longest record is only a year and a half. As a school boy I domesticated a litter of mice; they remained alive for about a year.

Bamboo Rat, *Rhizomys badius*. A specimen lived in Calcutta for at least three years; another lived in the London Zoo for nearly three and a half years.

Porcupines (*Hystrix* spp.) and Brush-tailed Porcupines (*Atherurus* spp.) live from eight to twelve years, extreme longevity in *Hsytrix* being represented by a specimen that lived to nearly twenty and a half years in the London Zoo. Hares and rabbits " live to an age of five or six years, and exceptionally to twice as long."

The specific and potential longevity of the Indian Elephant appears to have been greatly exaggerated by several writers including Blanford. According to Flower there is no " absolutely convincing evidence of an Elephant living to the age of 100 years." Of sixty elephants seen by him in India and Burma in 1913 the oldest were under fifty-five years of age, while from records of elephants outside India "that have lived longest in their respective new homes we find that they have an average life of a little over twenty-eight years" and it is reasonable to suppose that elephants survive even better in captivity than they do in the wild state. From the evidence of dentition seventy years would appear to be a liberal estimate of the potential longevity of an Indian Elephant. It is also of interest to add that elephants become sexually mature at an earlier age than is commonly supposed. Cases are known of

elephants that have calved when between thirteen and sixteen years of age.

Asiatic wild Asses average a life (according to twenty-three records) of about fifteen and a half years and may live to twenty-two years or more. Records of Kiangs, *Equus kiang* (*E. hemionus*) show that individuals may live in captivity for periods ranging from eighteen to twenty-five years. A female Indian wild Ass died in the London Zoo after nearly sixteen years of captivity.

Most rhinoceroses are said to live for less than ten years in captivity, but "twenty-seven selected individuals show an average life of almost twenty-two years," and individuals have been known that have lived for over forty years. Fifteen records of the Great Indian Rhinoceros, *Rhinoceros unicornis*, show an average life of about twenty-nine years, a minimum of fifteen and a quarter years and a maximum of forty-seven years. An individual of the smaller Sondaic Rhinoceros, *R. sondaicus*, lived in the London Zoo for nearly eleven years, and another in the Calcutta Zoo for over fourteen years. Four records for the two-horned Rhinoceros, *R. sumatrensis*, show a life between ten and thirty-five years.

The majority of Tapirs live less than six years in captivity, but their potential longevity is at least thirty years. The average for eighteen individuals over seven years of age is about fifteen years. The longest records in the London Zoo for Malay Tapirs, *Tapirus indicus*, are nine and a half years for a male and a little over eleven years for a female. A Tapir, probably the same species, lived in the Trivandrum Zoo for twenty-three years.

The larger wild cattle have a specific longevity of nine to twelve years, and a potential longevity of twenty to twenty-five years, or even (but very rarely) thirty years. The Domestic Humped Ox, *Bos indicus*, frequently lives between ten and fourteen years; a pair of gayals, *Bibos* (= *Bos*) *frontalis*, lived in London for about fifteen years; Yaks, *Poephagus* (= *Bos*) *grunniens*, are capable of breeding to at least eighteen years of age, six records of long-lived Yaks ranging from fifteen to nearly twenty-four years. A very long-lived Asiatic Buffalo, *Bubalis* (= *Bos*) *bubalis* lived in

captivity for over twenty-nine years and must have been over thirty years of age when it died.

On wild sheep, goats, goat-antelopes, and antelopes the following information is available:—

Urial, *Ovis vignei*. Three individuals have lived for over eleven years in the London Zoo.

Bharal, *Pseudois nahoor* (*Ovis burrhel*). Ten individuals have lived in the London Zoo for over eight years each, and some have survived for periods ranging from thirteen to sixteen years.

Markhor, *Capra falconeri*. Like the common goat, *C. hircus*, the ordinary life of the Markhor and other wild goats is eight to ten years.

Himalayan Ibex, *C. sibirica*. A female was killed in the London Zoo after having lived there for a little over twenty-two years.

Thar, *Hemitragus jemlahicus*. The ordinary life is as for the goat, but individuals may live to twelve to fourteen years and even to over sixteen years.

Nilgiri Thar, *H. hylocruis*. Probably the same as the above. A specimen lived in the Trivandrum Zoo for nearly seventeen years.

Goral, *Naemorhedus* (= *Cemas*) *goral*. A male lived in the London Zoo for a little over eleven years; another survived for nearly eighteen years.

Takin, *Budorcas taxicolor*. A male lived in London for nearly nine years; a female is still alive there after about eight years.

Blackbuck, *Antilope cervicapra*. Several records show that this antelope seldom lives longer than seven years in captivity, but individuals may live to fifteen years.

Four-horned Antelope, *Tetracerus quadricornis*. A specimen lived in the London Zoo for seven and a half years; another is said to have lived in Pretoria for ten years.

Nilgai, *Boselaphus tragocamelus*. This species does well in captivity and produces twins regularly, but the maximum ages it reaches are very moderate, being generally between eight and

twelve years. An exceptional female in the Antwerp Zoo is said, however, to be more than twenty-one years old. The Superintendent of the Zoological Gardens, Calcutta, gives the average age (in a letter to the Forest Entomologist) as ten to fifteen years, the same period being also applicable in his opinion to other large antelopes.

For deer the following records are available for Indian species:—

Muntjac or Barking Deer. Major Flower does not give definite records for the Indian species, but it would seem that these animals seldom live more than six to eight years.

Chital, *Axis* (= *Cervus*) *axis*. The records for twenty-five selected individuals show an average of about ten years. The longest records range from twelve to fourteen years, but an exceptional individual lived in Paris for almost nineteen years. The Superintendent of the Calcutta Zoo informs us that the average age is ten to fifteen years.

Hog Deer, *Hyelaphus* (= *Cervus*) *porcinus*. The longevity of this species is similar to that of the Chital.

Sambar, *Rusa* (= *Cervus*) *unicolor*. The longevity of this species is also similar to that of the Chital, but more cases of individuals attaining ages between fourteen and eighteen years are known.

Barasingha, *Rucervus* (= *Cervus*) *duvaucelii*. This species, and other Rucervine deer, appear to have a longer life than the Chital and Sambar. Records are given by Flower of specimens that have lived for periods ranging from a little over fourteen years to twenty-three years. The average life is probably in the neighbourhood of twelve years.

Thameng or Eld's Deer, *R. eldii*. Three records, showing a life of thirteen years, are given by Flower.

Hangul, *C. hanglu* and Wallich's Deer, *Cervus wallichi*. These Kashmir deer may live for thirteen to fourteen and a half years according to the two records given by Flower

Regarding the Indian Wild Boar the Superintendent of the Calcutta Zoological Gardens informs us that they live for fifteen to twenty years, but Flower's records for wild swine show that twenty years is the potential longevity, the average being in the neighbourhood of ten years. An Andaman Boar, *Sus andamanensis*, lived in the London Zoo for a little over twelve years.

It may be of interest to add that among domestic animals the ordinary extreme age for cats is about fifteen years; the average life of a dog in England is less than four years, though the potential life is very much more. A dog is old at ten years, but cases are known, especially among terriers, of survival to twice this age and more. Of horses it is said that given a fair chance it is not unusual for them to live to, and be capable of reproduction at, twenty five years, the average extreme age being in the neighbourhood of thirty-five years. The oldest age claimed for a horse is sixty-two years, and authenticated cases of horses living for forty to fifty-five years are known. Donkeys may live for forty to fifty years, but the average good life is probably about twenty years. Mules appear to have much the same span of life as donkeys. For domestic oxen and cows the specific longevity lies between five and twelve years, for sheep between seven (ewes) and twelve (rams) years. Goats have an ordinary life of eight to ten years, but may live and be useful for much longer. A camel generally passes the point of utility at twenty years, and should not be used for hard work before it is six years old. The extreme age of a camel may be about forty years.

In concluding it may be stated that, contrary to popular belief, man tops the list of long-lived mammals. The biblical span of 'three score years and ten' is a fair average, but individuals may live to a hundred years and even much more. The Asiatic elephant and the horse are the longest lived mammals after man. Insectivorous bats, insectivores, and small rodents are the shortest lived mammals, their maximum expectancy of life being in the neighbourhood of five years. In such cases the equilibrium of population is maintained by great fecundity.

CEDRIC DOVER.

THE HOLY KAILASH MOUNTAIN.

BY KAILASH CHANDRA, RANGE OFFICER, KAILASH RANGE, UPPER BASHAHR FOREST DIVISION.

Kailash peak is said to be the residence of Lord Shiva and is, therefore, considered to be sacred. There is a common belief that a tour round this peak washes away sins and promotes the fulfilment of one's desires. A tour round Kailash can be completed in 10 days, walking daily without a halt. The journey is so difficult that it is the real place to do away with sins, but the other object regarding the fulfilment of one's desires remains to be verified.

The holy Kailash is well over 22,000 feet above mean sea level; it is conical in shape and looks like a temple and is situated in the inner Himalayas in Bashahr State of Simla District bordering on the Tibetan plateau. It is encircled by 3 beautiful valleys, the Sutlej valley to the north-west, the Tiding valley to the east and the Baspa valley to the south west. All the three valleys are situated in similar country, but they are very different in vegetation and are full of forest interest. It is not that this trip is interesting from a religious point of view, but a forester will be greatly benefited if he walks with zealous eyes for forestry. A shikari will be pleased to find big game in the upper parts of the Tiding and Bashahr valleys. It is recommended to all forest officers who happen to visit Bashahr to complete the tour as it is the place to learn all about the natural phenomenon.

The first march of the trip commences from Kilba, 130 miles from Simla, along the Hindustan Tibet road. Kilba to Shontong is 10 miles (6,000 ft.), Shontong to Purbani 8 miles (8,000 ft.), Purbani to Thangi 10 miles (9,000 ft.) which is the end of the Sutlej valley, and a forester will see beautiful forests of deodar in the dry zone with lovely young regeneration between 7,500 ft. and 15,000 ft. Above the deodar belt there is a small strip of *Betula* and *Rhododendron* species and then the lofty Kailash Range covered by the perpetual snows. In the lower part of the deodar forests there is an admixture of *neoza* (*Pinus gerardiana*) and lower down nothing is to be found but pure *neoza* trees growing

scattered along the precipitous and sheer rocks. Here a forester will be asked to solve a critical problem as to how the *neoza* seed can stick to these vertical rocks and how the seedlings can draw their food and grow to a big tree in the absence of soil and under the influence of drought, as the rainfall is only scanty, being from 6 to 9 inches from April to September. Grass is almost absent in this valley, *Artemisia* species forming the ground cover and scattered *Ephedra* species are not uncommon.

Now a traveller will march in the Tiding valley from Thangi to Kuna Charang, 15 miles at an elevation of 11,500 feet. The whole journey is along the watercourse of the Tiding stream and is full of danger and devoid of vegetation, shut in by rocky mountains on both sides. The valley opens out at Kuna Charang and a vast area, lakhs of acres, is lying barren and devoid of any tree growth for want of rain and looks like the dry hills of Baluchistan between Harnai and Loralai. At Charang there is an old temple said to have been built by Pandu brothers but lately possessed by Buddhists.

Charang to La-lanti is 10 miles at 14,000 feet, just below snow clad peaks and with no habitation within a radius of 10 miles. A traveller will pass his night here under the open sky unless he is carrying his tent or shouldari with him and even then he will pass a difficult night at this stage as fuel has to be carried up from 3 miles below. It is very desirable that some charitable person should build a hut at this stage of the journey.

La-lanti, the main pass of the Kailash Range, is 5 miles walking along the watercourse of a nalah with fearful mountain ranges on both sides and there is every danger of avalanches. Here is the place where a traveller will forget everything of the world but will examine closely the work of God.

Just below the main pass begins a steep climb from 16,000 feet to 17,000 feet to the main galli, over a distance of about 15 chains and there is every danger of wind in the late hours of the day. A rope is most helpful in this difficult climb over snow as some nervous people might feel giddy and fall.

From the main pass there is an abrupt fall to Chhilkul village (11,500 feet) covered in a distance of 5 miles in the Baspa valley. The Baspa valley is more like Kashmir and Kulu valleys, but does not possess the lovely towns of Srinagar and Sultanpur and only possesses Sanglah village, 15 miles from Chhilkul (9,000 feet), at which there is a Forest Rest House. The vegetation changes altogether and an absolutely different type of forest is met with. The forests are of the moist zone type with fine grass on waste grazing grounds in abundance and they are richer in flora than those in the Sutlej valley.

It is interesting to note the formation of new forests on the banks of the Baspa river. Huge stones, sand and silt are washed down the mountain ranges by avalanches and settle down on the river banks, and a good many field-like plots are formed, which are gradually covered with grass, herbs and shrubs. After this and when the soil is improved, *kail* (*Pinus excelsa*) comes in slowly and a *kail* forest is formed with an admixture of broad leaved species. After this deodar (*Cedrus deodara*) begins to grow slowly and scattered. In the lower part of the valley deodar has been favoured and *kail* has been cut back and thus pure deodar forests have been formed on both banks of the river. *Kail* predominates in the upper part of the valley and deodar in the lower part.

Sanglah to Kilba is 14 miles and is the end of the trip.

It is not so difficult and dangerous to complete this tour as people would imagine since the writer of this article crossed the main pass on the 27th September, 1931, accompanied by his family, including a boy of 8 years old, although it snowed all day long and there had been a fresh fall of 1′ 8″ on the main pass.

TAUNGYA IN GARO HILLS DIVISION, ASSAM.

By R. N. De, I.F.S.

The Garo Hills Division comprises the whole of the Garo Hills which are inhabited by a hill tribe called the Garos, who have been practising *taungya* cultivation from time immemorial. The district contains some of the most magnificent sal forests of India,

The forest reserves are fairly well stocked with sal and its natural regeneration is also abundant. The *taungya* system was introduced years ago to restock the blanks or to get rid of *kokat*. Teak, *gamari* (*Gmelina arborea*), and sal have been tried in the *taungyas* and here and there a few trees, or groups, may be found all over the Division. The work has been, at the best, spasmodic and no system is evident either in the method of cultivation or in the keeping of records. The inevitable result has been that most of the *taungyas* are now lost and forgotten, although a few of them have undoubtedly been a success.

Matters improved in 1928, when a more systematic method of cultivation and record was introduced and *taungyas* have been a regular feature of the Division since then.

In the cold weather, the Divisional Forest Officer goes round the Division selecting sites for *taungyas* and the cutting of the jungle begins by the last week of December or early in January. A clean sweep is made of everything standing on the area and the stuff is allowed to dry for burning. There being no good market even for sal poles, not to speak of *kokat* and bamboos, nothing can be sold from the clearings. The refuse is set on fire in March after there has been a dry spell for several days. One burning is usually sufficient to clear the area, but if any unburnt material, still remains as the result of rain or for other causes, it is collected in heaps in different parts of the area and reburnt.

According to our terms, the same *taungya* is to be cultivated successively for 3 years. In practice, however, there are very few *taungyas* that are cultivated for more than two years, although the villagers do weedings in the 3rd year's *jhum*, even if they do not carry out any cultivation. *Jhumming* is allowed all over the district, except in the reserves and in certain small forests (village forests), but the *jhummers* do not like to do our *taungyas* if they can help it. The soil outside the reserves has been constantly *jhummed* at intervals varying from 5 to 12 years according to the density of the population in any particular area, and the greater fertility of the virgin soil inside the reserves is too great a temptation for some people living near them to withstand.

The villagers we have to deal with, therefore, usually want to work for themselves and it requires a firm, but yet kind, handling of the villagers if the *taungyas* are to be made a success. Moreover, the Garos have very few wants and so long as they are satisfied they do not care to work more to ameliorate their condition, much less to provide themselves with present day luxuries. They are ready to quit the reserves if they find our work trying and every year some people leave them, but others enter.

After the *jhum* has been burnt and the ashes raked over the field, millet and Indian corn are sown broad cast early in April. Soon after they put in stakes 8′ apart between the lines along the contours and 8′ and 10′ apart alternately in each line. The 10′ lengths are sown with sal seeds, 4 in a row, one foot wide, the distance between the rows being 6 inches. Thus each line is interrupted by a 8′ gap, to allow more room to the villager for his crops. Previously our lines were continuous, but subsequently the interrupted lines were introduced. The *jhummers* do not appear to appreciate the change much, but they realise that they have at least to collect and sow less seeds than before.

With the early showers of local rain, which we usually have from March onwards till the advent of the monsoon, the seeds of the field crops begin to germinate. By the last week of May, sal seeds begin to ripen, but in some places in the inner hills we have to wait till about the middle of June for ripe seeds. Seeds are collected from the trees, but, if they fall off owing to a heavy storm they are picked up from the ground also, and sown in the lines after the soil has been loosened with a small hoe. Before sowing, the lines are cleared upto 1′ width of all millet and other plants and sal seeds are dibbled in the loose soil to the depth of their own thickness if the soil is moist. On rather dry soils, or where drought is feared, they are pushed well into the ground so that only the tips of the wings are visible. Deep sowing is also resorted to on steep slopes where the seeds are likely to be washed away by rain. Sowing of seeds with or without wings, or vertically or horizontally does not appear to make any difference whatever to the incidence of germination or to the growth, but seeds with wings are preferred as they show up above the ground and are

easy to inspect and are not easily carried away down the hill slopes by rain. Germination starts in a day or two and it is often found that as the sowing proceeds from day to day, the germination also goes on and before a field is finished almost a quarter of the seeds has germinated.

Once the sowing has been completed in time one can look forward with some confidence to success, but there are many difficulties to contend with before a good *taungya* can be created. To start with, there may be a complete failure of sal seeds which drives the Divisional Forest Officer almost mad in his frantic efforts to replace sal by other kinds of seeds, or there may be a severe drought during the period of seed ripening or a storm may blow down all immature seeds. All these difficulties have been faced sometime or other here. In the absence of sal, teak, *gamari* (*Gmelina arborea*), *cham* (*Artocarpus chaplasha*), *amari* (*Amoora spectabilis*) and *poma* (*Cedrela toona*) seeds have been sown direct at stake with occasional success. From the condition of teak trees seen here, it would appear that teak will not yield sound timber as the stems have been badly damaged by borers (probably *Dihammus cervinus*).

Gmelina undoubtedly does very well and, being a fast grower, does not require weeding from the 2nd year onwards, but our forests are infested with sambhar which pull down every leading shoot, specially after a weeding. It is a question of preserving one or the other. In these days of rapid extinction of fauna, our reserves are the only haven for the unfortunate game and our policy is to grow species that will not be browsed by the deer rather than to shoot them. *Cham* (*Artocarpus chaplasha*) is another rapid growing species that can be sown in the *taungyas*, but in localities where wild elephants abound it is useless to grow it, as the elephants have wiped out many a promising plot. The only two species that are so far immune from the attacks of elephants and deer are *poma* and *amari*. In places where elephants and deer are not so plentiful *gamari* and *cham taungyas* have been grown successfully.

Given a good seed year and timely rain, sal *taungya* is the easiest thing to grow, but with the one or the other amiss, every

Fig. 1.—Millet and some Indian corn in jhum. Stakes show the line of sal (Rongrenggiri Reserve).

Fig. 2.—Sal taungya 8 months old (Bagmara Reserve).

Fig. 3.—Sal taungya 12 months old. Notice paddy growing in the jhum in the 2nd year (Angratoli Reserve).

Photos R. N. De

Fig. 4 —Sal taungya 19 months old (two lines). Bagmara Reserve.

Fig. 5.—Sal taungya 34 months old.
Bagmara Reserve.

Photos R. N. De

effort has to be made to grow 'something' in our *taungyas*. The Garos weed their field crops constantly during the rains till they are ripe. Besides millet and Indian corn, they grow sweet potatoes, cassava, cucumber, melon and many other vegetables and also cotton in their *jhums*. It is only after they have harvested their field crops in August or September, when brewing is going on in every house, that they have to be driven to their fields for a second weeding of the sal seedlings. At the end of the rains the seedlings are about one foot high. Fig. 1 shows a *taungya* during the first rains in which the sal seedlings are hidden by the field crops.

By the end of December or early in January, the Garos begin to clear their *taungya* again for a second year's cultivation. All weeds and other jungle growth are thoroughly cleared leaving only the sal lines. Fig. 2 shows such a plot (8 months old). The debris is burnt in March and after the ashes have been spread out paddy is dibbled in. The method of dibbling is very simple, a pointed stake being driven into the ground and a pinch of paddy then thrown into the hole made by the withdrawal of the stake.

The paddy lies dormant in the hole till a shower of rain starts its germination. By the end of August or early September, the paddy, which is now about 4′ high, is ripe and then only the ears are harvested and stored in the granary. Fig. 3 shows a sal *taungya* (12 months old) with paddy which has not yet grown to its usual size (May). As is the case of the first year, weeding is likely to be neglected after harvesting in the 2nd year also and this has to be attended to in time. In the winter of the 2nd year the sal seedlings are about 2′ high on the average, although 4′ seedlings are not uncommon in favourable localities. Fig. 4 shows a *taungva* in the cold weather of the 2nd year (19 months old).

Scarcely, if ever, is any crop grown on the same *jhum* during the third year, unless the soil is particularly good. Only in the Rongrenggiri Reserve are there instances where the same area has been cultivated in the third year. But in any case the villagers do two weedings in the third year's *jhum* during the rains, after

which their responsibility ceases. On good soil the sal seedlings have grown as much as 8′ during three rains. Fig. 5 shows such a *taungya* (34 months old).

There is no danger of the sal seedlings getting suppressed by weeds so long as there is some crop on the ground as the Garos constantly weed their fields. But the crop itself is likely to smother them if allowed to grow too close. After the crop is harvested their interest in the field ceases and greater activity is shown in brewing rice beer, and that is the time when one weeding must be done. Those that have a new *jhum* and also a previous year's *jhum* have to keep two *taungyas* weeded in time. Besides, every one who entered the reserve at least 2 years ago, will have a third year's *jhum* to weed. The villagers' hands are, therefore, pretty full, but they are fortunately, assisted by their wives and grown up children, if there are any. No payment is made to them by the Forest Department nor do they pay any house tax to Government. The *taungya* cutters cultivate good soil free of any rent, while the Forest Department gets its poor forest stocked with better species without any expense.

The other damages to which the sal crops are liable are by pigs and monkeys. Instances are known in which pigs have turned up a whole line of seedlings and have eaten their succulent roots, but this form of damage is usually confined to two-year-old seedlings. There is no remedy, but the pig is made an outlaw in all *taungyas* and can be shot at sight. Monkeys pull up the sal seedlings in the 1st year's *jhums* during the cold weather when they cannot get any other kind of food in the field. A reward was given for shooting monkeys discovered actually pulling up seedlings and for hanging up their dead bodies in the fields. A few monkeys shot seem to have served as a deterrent, but it is too early yet to express a definite opinion as to the efficacy of this experiment.

Our *taungyas* are by no means popular with the Garos, but they readily respond to sympathy and kind but firm treatment. There are already signs of greater demand for *taungyas* inside the reserves, and the future does not seem to be so very distant

when it may be possible to regenerate most of the reserves of the Division by this method alone.

NEW YEAR HONOURS' LIST.

We offer our congratulations to the Members of the Forest Department who figure in the recent Honours' List published in the Gazette of India (Extraordinary) of 1st January, 1932 :—

RAO BAHADUR.

M. R. Ry. Rao Sahib Kodumudi Ramaswami Venkataramana Ayyar Avargal, Deputy Conservator of Forests, Madras Presidency.

KHAN SAHIB.

Khan Muhammad Khan, Extra Assistant Conservator of Forests, Punjab.

AHMUDAN-GAUNG TAZEIK-YA-MIN.

U Sein, Burma Frontier Service, Extra Assistant Conservator of Forests, Katha, Burma.

REVIEWS.

SEEDING AND PLANTING IN THE PRACTICE OF FORESTRY.

BY J. W. TOUMEY, SECOND EDITION REVISED BY C. F. KORSTIAN: PUBLISHED BY J. WILEY & SONS, NEW YORK, 1931. PRICE 25 SHILLINGS.

The previous edition of this book in 1916 was welcomed by foresters in many other countries besides the U. S. A., as it supplied a felt want. Since then the output of forestry literature has increased greatly, and methods of work, particularly in nursery practice, have been improved upon, so that a revision of this textbook after a lapse of 15 years was doubtless considered necessary. After a careful examination, however, one is surprised to

find how little the first edition has had to be altered, and this testifies to the efficiency of Professor Toumey's methods in writing the original. Alterations are mainly in the direction of labour-saving devices and the adaptation of agricultural instruments to the needs of forest work.

The two main objectives of artificial regeneration work are clearly defined as reduction of costs and increase of percentage survival, the two together determining the relative efficiency of the many methods discussed. With the greatly increased cost of manual labour in India it behoves us to keep abreast of developments in any labour-saving "gadgets" which might be applicable to our varied local conditions, and for this reason the revision should be in the hands of all forest officers.

The only completely new chapter in the revision is that on "Planting Plans and Surveys". Under American conditions the provision of separate planting plans is doubtless necessary, though in most countries such work is covered by a chapter in the general working plan. In carrying out the detailed survey work for any large planting scheme, the author recommends the use of the "strip method" of ordinary woodland surveys, working over one chain strips spaced 10 or 20 chains apart to obtain data for planting up the whole area. To classify this method as "intensive", however, appears to be hardly accurate, as planting estimates for cost and number of plants worked out on such a basis could not be more than approximate for the rough type of country to which planting schemes are usually confined.

Fresh data are given of seed-extracting plant which might be of use in our Himalayan conifer areas. Simple types for hand working are compared with more elaborate schemes requiring a 6 horse power engine to work the conveyor, cone thresher fanning mill, and seed grader. Much new information is also given on the cold storage of seed, which has come much into use, and is now the standard American practice for seed of balsam firs and several pines, including the longleaf pine so much grown in the Southern States. Figures are quoted to show the marked increase in germination percentage obtained from seeds stored in refrigerators and in properly constructed seed-stores with regu-

lated temperature and humidity, as compared with ordinary rough methods. Such considerations are important for many of our Indian species, such as Himalayan oaks which will not stand any drying.

New facts are given on the hastening of germination, including soaking seed in various solutions, one hour treatment in 0·5 to 4·0 % sulphuric acid being the common successful one. Germination by warming the soil with an electeric current of low voltage passed along lead wires in the soil of seed beds, which is mentioned as being used by one lumber company, is now regularly used by several of the more progressive nurserymen in Scotland, as is also the use of a brazier torch for destroying weed seeds before sowing up nursery beds. Chemical weed eradication is also mentioned in this new edition, but it is hardly likely to be of use in India, for chemical treatment that is strong enough to arrest the growth of the average monsoon weed crop is likely to affect tree seedlings adversely.

Root pruning is now fully dealt with, but the elaborate types of wheeled pruners which cut roots along the whole width of a 4-foot nursery bed appear to be impracticable for any average nursery soil, as also is the method of using a long-bladed knife underground. Undoubtedly the best practical method is the simple one of working along each row of seedlings with an ordinary flat spade with a specially sharpened edge, thrusting it through the soil at an angle which will sever the roots at the desired depth. This has been the standard practice in Scots nurseries for many years for all deep-rooting conifers, and provided it is carefully done, it gives infinitely better rooted plants than where the tap-root is allowed to develop undisturbed or is cut during transplanting. This should be applicable in many of our Indian divisions, *e.g.* Chakrata, where heavy expenditure is incurred each year on the complete transplanting of all deodar seedlings in the nurseries, and in spacing individual plants much too wide in the transplant rows. Korstian now gives $1\frac{1}{2}$ to $1\frac{1}{3}$ inches as the proper spacing between plants in transplant rows for most "two-year one" conifers.

Some emphasis might well have been put upon the need for sorting transplants into grades whenever they are handled, either for pricking out in beds or for sending to the planting area. Recent work by the British Forestry Commission has shown that grading always pays. Take for instance the handling at the 2-year stage of what are nominally 2-year 1 pine and spruce plants; if 3 grades are sorted, the largest plants can be sent direct to the forest, thus saving the expense of a further period in the transplant beds; the middle grade is treated in the ordinary routine; and the undersized "culls" are destroyed, for even if they constitute quite a large percentage of the crop, it is realised that they are a bad investment. No amount of nursing in the transplant stage will make a backward seedling a good tree of the future, and all such are therefore burnt. This is a lesson which is badly needed in much of our Indian nursery work, where too often time and money are wasted by filling our plantation areas with badly-bred "C 3" plants which painstaking *malis* have saved from a well deserved bonfire.

The use of a small hand baling press for the packing of transplants which have to travel some distance on pack animals might be of considerable use. It is a simple baling frame in which wooden strips and tie wires, previously cut to the required lengths are placed, then a strip of gunny wrapping and some wet moss. The plants are set in a double tier with the roots towards the centre, and the whole bundle is compressed and wired up, just as in baling hay.

The sections on insect and fungal pests have been dealt with in much greater detail in the revision, and several recipes for baits and poisons for cutworms, aphids and grasshoppers might prove useful to the worried *mali* when dealing with his *bêtes noires.*

A useful improvement is the bibliography, which is listed at the end of each chapter. In length these lists are imposing, but in quality they are disappointing. Dr. Korstian has drawn almost entirely from American and German sources, and has hardly touched other literature. India's one contribution is a reference to Howard and Champion's "Seed Weights and Plant

per cents. for Indian Trees, 1928" as a model for the early publishing of available data. Contemporary British references are few and include only Troup's "Silvicultural Systems" and one British Forestry Bulletin on nursery investigations. French experience in the fixation of sand dunes is covered only by an out-of-date pamphlet published in 1878. Cockayne's report on the dune areas of New Zealand is mentioned, but no reference is made to this work in Palestine or to the Culbin Sands on the Moray Firth, both now recognised as amongst the most successful fixation schemes in the world.

A word of protest might also be excusably lodged about the distressing and almost overpowering smell which seems to be inseparable from new publications from the U. S. A. The reproduction of print and of illustrations is excellent, but from the reviewer's standpoint the smell of new American books is a decided snag. This however is not Dr. Korstian's fault, and he is to be congratulated on a notable addition to forestry literature.

R. M. G.

ANIMAL ECOLOGY.

Some at least of the readers of the "Indian Forester" are interested in ecology, though there are doubtless many in whom the work produces no mental reaction unless it be one of repulsion. Among the responsive few will be some whose interests are botanical, but it is not primarily for them that this note is penned. There will be others who are more interested in animal than in vegetable life, which to them appears relatively so inanimate. But among those showing negative tropism to the sound stimulus of the word 'ecology', will be many who are reacting rather more physically than mentally, having a false impression of what the term really implies; these are the people who may not care a rap whether a tiresome weed is called *Eupatorium* or *Ageratum* and whether it comes from America, China or Timbuctoo, with or without the Prince of Wales as intermediary, but who are truly interested in the numerical relations between carnivora and deer,

in the reasons for the spread and increase of one species and the diminution of another, and in the causes of the periodic recurrences of years of unusual frequency or of migrations in animal and bird life. It is to the two classes last mentioned, namely those who do not mind being included in the term 'ecologists' and those who do, but confess a keen enough interest in problems such as those listed, not to be frightened off by an occasional scientific name, that we would invite notice of the impending appearance in 1932 of a new Journal to be called '*The Journal of Animal Ecology.*' The subscription will be thirty shillings per annum and we venture to predict that one will get ones money's worth, even in these bad times. The editor will be Mr. Charles Elton, University Museum, Oxford, to whom communications and subscriptions should be sent. It should be mentioned that the flourishing *Journal of Ecology* will continue in future to publish papers on botanical ecology as well as comprehensive bilogical papers dealing with both animals and plants, such as the effects of grazing on plant succession.

H. G. C.

AN OUTLINE OF FOREST PATHOLOGY.

BY ERNEST E. HUBERT.

Published by John Willey & Sons Inc. New York, Chapman and Hall Ltd., London, 1931 ; price 30 s.

This work is avowedly a general description of diseases of European and specially American forest trees and embodies a large mass of general information on some of the well known temperate fungal pathogen. The book is divided into three parts and each part into chapters and under each chapter the subject heads are treated in detail.

The first part, which is divided into seven chapters covering a variety of subjects on forest pathology, such as the history, the classification, the factors, the losses and the symptoms, is introductory and the subject of tree and timber diseases is treated in a

general fashion. It is important for the worker to recognise a disease or a rot in its early stage. The aetiology of the disease, described in Chapter VII, is always a welcome introduction in a treatise like this. The outlines of tree and timber diseases have been treated in a clear and interesting manner. The synopsis though sketchy and condensed includes numerous known items of disease.

The second part describes in detail numerous diseases of forest trees, a subject, which interests a pathologist. The first chapter (Chapter VIII) of this part deals with the so-called physiological factors under "non-organic physiogenic agencies" followed by Chapter IX on parasitic diseases due to organic agencies. Each disease has been treated under different sections, *viz.*, a general description, the external symptoms, the pathological histology, the morphology of the parasite, the amount of damage, the control, and a short bibliography containing essential reference. A large number of parasites including the phanerogamic ones has been dealt with. The interesting feature of this part is that the author has given a timely warning that in an intensely managed forest, diseases, which are generally regarded as of minor importance or appear less harmful, may take a serious course in future. Several pages are devoted to some important forest rusts, needle casts, blights, canker diseases and rots.

The Uredinales (Protobasidii), which include a large group of obligate parasites infecting the needles and stem of conifers and are always dispensed with in a few words in a general treatise, have been well described. The subject covers over 40 pages with a large number of fine illustrations.

The Eubasidii, which consist of the majority of the timber rot organisms, except for the description of the cultural characters of the rots, which are meagre, have received detailed treatment. Important diagnostic characters of the rot from the timberman's as well as from the pathologist's point of view have been summarized. The terminologies used in naming the rots such as *brown string rot* (*Echinodontium tinctorium* E. & E.), *yellow ring*

rot (*Poria weirii* Murr.), *pitted sap rot* (*Polystictus abietinis* Fr.), *string and ray rot* (*Polyporus berkeleyii* Fr.) etc., etc., which signify the character of the rot favoured by the American phytopathologists are not so familiar with general readers elsewhere. The concluding Chapter X of this part summarizes the control methods under four heads, namely, exclusion, eradication, protection and immunization.

The third part describes wood pathology, a subject introduced in a novel fashion. The physical, the mechanical and the Chemical properties of wood affected by rot have been discussed in a concise and semi-technical manner (Chapter XI) followed by Chapter XII on the relative resistance of wood to decay with a brief tabulated summary of methods followed by various investigators. Various decay-resistance factors such as resin, oils, specific gravity of the wood, the relative proportion of water and air contents of the wood, etc., have been dealt with. The chapter also contains a table showing relation of durability rating to specific gravity and another on the relation of sap-rot and sap-stain fungi to moisture content of various woods. This chapter ends with a discussion on the decay-resistance factors in Western Red Cedar (*Thuja plicata*) the wood of which is well known for durability and is regarded as suitable for constructional purposes, specially for structures in contact with the ground.

Of the remaining three chapters, one (Chapter XIII) has been devoted to the saprophytic, another (Chapter XIV) to the semiparasitic agencies and the last (Chapter XV) to a general summary of the methods of control of wood decaying fungi. Chapter XIII, which is aimed at to describe the rots affecting wood in use and in storage condition, is neither complete nor conclusive and leaves some of the common forms out of count. But the following Chapter XIV offers a detailed description of sap-stain fungi, a group of semi-parasites on which the author is well-known for a large number of original contributions. The book ends with an index.

Distinct in itself, the book, though dealing with a series of technical subjects, avoids technicalities of term as far as prac-

ticable, and has a large number of clear illustrations of rots, diagrammatic sketch of decay and photo-prints of the forests infected, etc., to illustrate the description. The work has been a success in incorporating a great mass of information on various allied subjects of forest pathology which are not always available to a general reader. From the wide treatment of these subjects the book will be equally valued by a forest pathologist, a wood-preserver, a lumberman and a forester.

K. D. B.

EXTRACTS.

THE STUDY OF FOREST ENTOMOLOGY IN INDIA.

Thirty years ago the entomology of the forests of India and its study were still a closed book. Types of forest insects had found their way into the national museums and private collections in Europe, and thus received a name. But, as became apparent during the first decade of the present century, numbers of the insects of forest importance, as probable or possible pests, were unnamed and their biology unknown. The early pioneer work of the forest officers who were first set to grapple with the position proved by no means easy, but extraordinarily fascinating.

In India, during those first few years, the assistance of a dozen or two expert systematists was required to enable progress to be made at all, and the preliminary publications of results (expected by and demanded by Government) to be issued.

The Indian Forest Records, Parts 9 & 10 (Calcutta; Government of India Printing Office, 1930), afford a typical example of this progress. Both these parts are devoted to the genus *Xyleborus*, a genus of wood-borers (the so-called pinhole and shothole borers) well-known to foresters. In Part 9, Hans Eggers, of Stolberg, Harz, Germany, discusses "*Xyleborus* Arten (Col. Scolytidæ) aus Indien" In this paper the author describes some forty new Indian forest species and also proposes a new genus, *Pseudoxyleborus*, in which he describes one species, *P. beesoni*.

Part 10 of the Indian Forest Records is written by Dr. C. F. C. Beeson, Forest Entomologist at the Dehra Dun Research Institute, and is entitled the "Biology of the Genus *Xyleborus* with more New Species." Chap. I. is devoted to the new species, and is indicative of the valuable knowledge we now possess upon this important genus. Chap. ii. is devoted to the main theme. "The present Record," the author says "summarises the available biological information on Indian species of *Xyleborus*, their regional distribution, food plants, life histories, and gallery patterns." The importance attached to the systematic study of groups of pests of this type, if solely from the economic point of view, will become evident from the following remarks: "Pinholes and shotholes in timbers in India are made by a specialised group of borers (often called 'ambrosia beetles') comprising the extensive genus *Xyleborus*, as also *Webbia* of the family Scolytidæ, and Crossotarsus, Diapus, and Platypus of the family Platypodidæ. The term 'pinhole' is applied to holes the size of a pinprick and 'shotholes' to holes corresponding in size to various small shot up to 3 mm. in diameter; otherwise there is no fundamental difference in the mode of origin of the holes or in the habits of the borers in making them. The tunnels are bored in wood by the female beetle, and the wood-dust resulting from their excavation is thrown outside, so that a free space is provided in which eggs are laid and the larval breed is reared to maturity. Unlike the majority of borers of timber, the larvæ of ambrosia beetles do not feed on wood, but on fungus (the ambrosia) that grows on the walls of the tunnel in a mycelial layer of variable thickness and produces highly nutritious fruiting bodies. Tunnels that have been occupied for a short time get stained black, and in some species secondary saprophytic fungi develop, that discolour the wood vessels for a little distance around the tunnel. Timber that has been attacked by pinhole and shothole borers thus shows defects in the form of black spots and lines on the sawn surfaces, which spoil it for ornamental purposes and for special uses as matches, veneer, plywood, etc.; unless heavily attacked it is not seriously weakened for structural purposes."

The paper ends with an excellent index to food plants of Indian species of *Xyleborus*. The author is to be congratulated upon an excellent piece of work.

Of a different type, emanating from the same Research Branch at Dehra Dun, is the series of papers dealing with the immature stages of the Indian Coleoptera, by Mr. J. C. M. Gardner (Indian Forest Records, Entom. Ser. Vol. 16, Part 3, 1931). Mr. Gardner produces his eighth paper, "Cerambycidæ (continued)," which completes the description of the identified material in the Dehra Dun collections. The classification of the family Cerambycidæ, and, says the author, "especially of the sub-family Laminæ has always presented difficulties to workers, who have relied almost entirely on the external morphology of the adult; the study of immature stages should help in a more satisfactory phylogenetic grouping of genera. So far, attention has been concentrated on larvæ, but the pupal stage certainly deserves more attention than it has received."

That Indian research work should be giving what might almost be termed a lead in a branch of study which may prove of considerable practical importance would seem to merit being placed on record. Certainly, Mr. Gardner's admirable and patient work should enable the forest officer out in the forest, or in the temporary timber depôt, to recognise a pest, abundantly represented by the larvæ in the timber but with no trace of the perfect insect; a position only too well-known to many forest officers.

(*Nature, 31st October, 1931.*)

REDUCTION IN THE FORESTRY COMMISSION EXPENDITURE.

In a memorandum on the measures proposed by His Majesty's Government to secure reductions in national expenditure, which was issued as a White Paper (Cmd. 3952) on September 10, it is stated that:—

The expenditure of the Forestry Commission in 1932 will be reduced by £478,000. This reduction will be secured by restricting afforestation work and acquisitions and by suspending the provision of forest workers' holdings. Care will be taken that the Commissioners' nurseries of young plants are not prejudiced.

In order that this large cut may be viewed in its proper perspective the following paragraph is quoted from the Annual Report of the Forestry Commissioners for the year ending September 30th, 1930:—

The balance of the Forestry Fund at the commencement of the forest year was £349,466. Receipts from Parliamentary votes and operations amounted to £1,086,137, payments to £808,237. and the balance at the end of the year was consequently £627,366. Balances remaining in the Fund at 30th September are large because the forest year closes in the middle of the financial year.

It will be seen that the reduction in expenditure is nearly one-half of the annual receipts. It is understood, however, that, in spite of the cut in their finances, the Commissioners will still be able to maintain a planting rate of upwards of 20,000 acres per annum, and, further, that grants for private planting will be available during the coming season on the same terms as in previous years.

(*Quarterly Journal of forestry, October, 1932.*)

THE AIM OF SCIENTIFIC FORESTRY IS TO AID NATURE.

(Winning essay for the "Indian Forester" prize for present students, by Sen Gupta, 1929-31 Division, Madras Forest College).

Though the term "Scientific Forestry" embraces more than one subject, for the present article it will be interpreted as "Silviculture" which is of course the soul of Forestry and is also suggested by the latter portion of the heading *i.e.* to aid nature.

Long before the subject of forestry was born and long before the present all-embracing civilization had its origin with its scientific advancement, the surface of the earth was covered with a most magnificent forest growth of natural origin. For the production of these forests no human interference, nor nursing and nothing of the sort were required. They sprang out themselves and grew themselves. But there was no body to observe the struggle out of which they arose. As a result of indiscriminate exploitation of these forests and an ever-increasing demand of mankind for forest produce it became necessary to maintain and improve these old forests and create new ones. Here "Silviculture" took origin and its present structure is the embodiment of the observations and experience of several centuries of the most cultured brain. From the present knowledge it can be said beyond a shadow of doubt that had the natural forests been treated judicially much better result would have been obtained.

What happens in nature as regards forestry? In nature forests grow themselves. If they are analysed it is found that there is a regular harmony as regards the distribution of species according to their respective silvicultural characteristics—*e.g.* evergreen and deciduous and sporadic habits, light or shade demanding nature, requirements of climatic conditions, etc. No human effort or application of scientific knowledge of forestry can interfere with these particulars. Nothing can change the inherent nature of the seed of any species. Nature herself has got many devices and contrivances to effect regeneration and formation of the subsequent crop. Then what is within the power of scientific forester to aid nature? And how is it effected? It has been seen that Nature's process is too slow to keep pace with the qualitative and quantitative requirements of mankind. Here nature fails to serve the wish of man without being

helped by him. So, the knowlege of silviculture, as revealed from the study of nature, comes to her aid in the following way.

Nature in the formation of Forest and Silviculture.

(*a*) *Treatment of the stand during the process of regulation*:—Seeds are available in nature on the trees. But it is seen that under various circumstances they cannot properly germinate and the tree cannot grow A few of these circumstances may be enumerated as follows :—

(1) Unfavourable nature of the seed for germination, *e.g.* very strong testa or very delicate or minute structure or short period of retentivity of germinating power, (2) Natural calamity, like falling of seeds by storm before maturity, or failure of timely rain, (3) Breaking of fire while the seeds are on the ground, (4) Unsuitable seed bed (hard, stiff, or baked), (5) Dense covering of grass or undergrowth. Silviculture can overcome all these difficulties and help nature.

The seed which has got very hard testa rendering easy germination difficult, is artificially treated by hot water or acid solution of certain concentration for a specific period, just to soften or wear away the hard testa and make it fit for quick response to the conditions of germination. Similary, the delicate nature and short rentenťivity of power of germination of seeds can be made to suit and adapt nature by treatment by a silviculturist.

As to the immaturity and quality of seed a silviculturist can gather in time the best quality of seed from the ideal specimens of trees for a particular locality and make the best use of them by distributing in nature. As to failure of rain, silviculture waters the plants till the period of crisis is over.

To protect the seeds and crop from fire the silviculturist has got an elaborate chapter on fire protection in forestry, by proper application of which he can secure the safety of his forest. The adverse nature of the bed due to hardening or baked nature may be overcome by timely wholesale tillage or working of soil in required areas. Obstruction due to dense grass or undergrowth to reach the seed upto the ground and subsequent suppression, are minimised by their removal. The opposing nature of wood land, like two equally powerful but hostile nations which repeatedly fight against each other for domination over the soil, can be successfully interfered by a silviculturist in favour of woodland.

It is most interesting to see that a silviculturist can overcome all the above difficulties by the application of a single and simple operation. It is the raising of a nursery. Here he can raise the plants, under desired circumstances, independent of the meteoric influences and can rear them till suitable conditions in nature permit them to be put in the forest.

In nature, the plants in their infancy, while establishing themselves on the earth, are faced by some invincible enemies. In the first place come

the noxious weeds. They compete with the tiny baby plant for light and rob most of the available moisture in the soil, causing starvation to the latter. They further choke the young plant from all sides causing suffocation. Silviculture saves the plants from this danger by the proper operation of "weeding." In the next place come the plants of inferior species, climbers etc., which are almost equally detrimental to the plants. Silviculture frees the plants from their clutches by "cleaning" and "climber cutting"

(2) *Treatment of the Stand after Establishment*.—In nature inferior species often flourish at the expense of better varieties. Silviculture eliminates and keeps them from re-appearing by the most thoughtful application of knowledge of "Improvement Fellings", thus helping, rather improving upon nature, in regulation of composition.

In nature sometimes forests are too sparsely or too densely stocked both of which are detrimental to the final value of the crop. Silviculture maintains throughout life, enough trees to stock the area properly and no more. In sparsely stocked area silviculture brings it into normal state by planting the gaps. In the case of densely stocked area it relieves the congestion of the crop by "thinning". It minimises the struggle for growth among trees and produces the maximum quantity and the best quality. It is interesting to note that apart from aiding nature, thinning has improved much upon the structure of the wood in specific gravity and hence in strength, especially of the ring-porous broad leaved species, like teak.

In nature, misshapen, crooked and defective trees, even of valuable species, are apt to accumulate and retard the development of the better individuals. Silviculture removes them and aids nature for the development of better ones.

In nature gaps are often created by fire, storm, logging or any other reason. These are atonce restocked by silviculture without waiting for nature to do it in a slow process—if at all.

(3) *Disposal of Slash*.—In forests, slash or debris often accumulates as a result of logging, wind, fire, or some other reason. This when properly disintegrated improves the quality of the soil and helps regeneration. But in nature the process of disintegration is too slow and it further exposes the forest to the risk of "insect and fungus attack", for which the debris is a favourable abode. A silviculturist disposes the slash either by progressive burning, by piling and burning, by broad-cast burning, by light burning or by simply piling, or lopping. Thus nature is much helped in improving the soil and ensuring regeneration.

(4) *Protection of stand against various injuries*.—Though nature has provided some plants, according to environment, with thick bark, spines, stinging hairs, etc., for protection against natural calamities and animals these are not at all adequate for protection of a stand against the injuries of a varied nature to which they are subject. Of these fire, insect, fungus,

and animals are prominent. Protection from these is necessary for successful growing of any crop. To aid nature, most efficiently, a silviculturist is led into various specialised fields—such as fire protection, entomology, pathology, etc. Here the help consists in classifying and describing the injurious agencies, revealing the scientific facts which are required in determining control methods and formulating and solving the administrative problems connected with control and prevention of losses, through the specialists in the respective branches.

(5) *Nature of individual species.*—One of the greatest boons of silviculture is the systematic knowledge of the nature of each individual species, and the best use of it has been made by aiding nature by artificial introduction of woods. The most valuable species often struggle in nature in mixture with other inferior species, for light, space and other requirements. A silviculturist raises them pure or in mixture with associates in plantations and gives every facility to grow. Here the crop, though of artificial origin,—everything subsequent is dependent on nature, subject to occasional interference of man So, principally, even in plantation, it is nature which is more easily and systematically aided by silviculture.

(6) *Nature herself* (*with vegetation and soil*).—Here the word nature will be considered in its most abstract sense. If nobody interferes with her, she smoothly goes on with her beauty and resources—to the utmost benefit of mankind. But indiscriminate action of man on nature in the mountains as regards her forest resources causes baldness on the surface of earth. Nature does not tolerate it calmly and the inevitable results that accompany are as follows:—The rivers become torrents when it rains, causing sudden flood over the plains with all its devastating consequences, like famine and epidemics, etc., the valleys are no longer supplied with water, the rivers become dry and irrigation becomes impossible. Hence it is seen that the prosperity of agriculture, the health of the inhabitants and public fortune depend upon a normal proportion of forests. Again this percentage itself is an element to regulate the world's circulation of cloud, rain, snow, flood and even the ocean. Hence the necessity of restocking the denuded zones in the mountains and establish order in nature, without which all economies are profoundly upset. It is only silviculture which can establish order in nature by restocking the denuded area, stopping further action of man and proper treatment of the mountain forests.

In conclusion it may be drawn up in a nutshell that the details and execution of all silvicultural systems—both permanent and provisional—corroborate the same truth of aiding nature to form a normal crop. All the experiments of research are actuated by the principle of establishing facts which will aid nature. In the Continent, especially in Germany, silviculture has advanced so much and is aiding nature in such an intimate manner that forestry has become almost like agriculture, from nursing and treatment point of view, with the difference that one is harvested biennially or annually, and the other after a quarter, a half, or one century. "Ramakrishna".

(*Madras Forest College Magazine.*)

UNKNOWN TREES OF THE EMPIRE.

NEW GENUS DISCOVERED IN WEST AFRICA.

The report of the Imperial Forestry Institute here which was issued to-day, describes the recent progress which has been made in acquiring a knowledge of the forest resources of the Empire, about which so much still remains to be discovered. The greatness of the task is not easily realized in this country, with its small number of tree species, and even in the Canadian forests there are only about 150 different sorts of tree, so that the forest officer can learn to recognize all of them at sight. But in the tropical territories of Africa and Asia the problem becomes infinitely complicated; for example, the Federated Malay States can boast of more than 2,500 tree species, while in the British possessions in Tropical Africa many of the trees are as yet nameless and their possible uses are entirely unknown.

More than 2,000 specimens sent in by officers of the colonial forest services were identified during the year, and the Institute has now embarked on the work of preparing lists of the trees and shrubs of the various parts of the Empire, for the use of the forest services. Among the specimens which have been sent to the Institute for identification during the year, 12 new species have been found, and one even of a completely new genus, which is being named after the discoverer, Mr. Chidlow Vigue, of the Gold Coast Forest Service.

Another new species which comes from Trinidad is a fairly common tree known locally as *bois lisette*, and the reason why it had not hitherto been identified is because it had never before been found in flower. The flower was discovered and sent to Oxford by Mr. R. C. Marshall, the Conservator of Forests in Trinidad, and the new tree is to be named after him. It often happens, as in this case, that the leaves of trees in the evergreen tropical forests are so similar to one another in shape and appearance that the experts themselves cannot identify them unless they see the flowers.

The work of identification is hampered by the fact that many of these tropical trees only flower at very long intervals. It is true that experts have now discredited the legend that the so-called "century plant" of America flowers only once in 100 years, but it is also true that many tropical trees come to flower only once in 30, 40, or even 60 years. There are trees in the Federated Malay States which, although they have been closely watched for many years by the forest officers, have never yet been seen in flowers. Many bamboos, on the rare occasions when they flower, do so simultaneously over the whole area.

As the colonial forest services in the Tropics have developed almost entirely within the last 15 years, it is not surprising that the work of ascertaining the Empire's forest resources still leaves so much to be done. Both the French and Germans were a little in advance of us in tackling

this work, and the representatives of the Institute who attended the Paris Timber Conference in July were impressed by the fact that the French appeared to know more about the trees of their Africa colonies than we know of ours, and that they showed themselves so fully alive to the importance of this knowledge The Germans also did much work on the same lines in Tanganyika Territory before the War.

The export of mahogany from West Africa has continued for many years, and it has now come to be realized that some preparation ought to be made for a time when the supply of such wood as is already known to be commercially valuable may show a falling-off. Not only the forest officers, but also the British timber trade, are eager to know something of the properties of the hundreds of other trees in Tropical Africa about which little or nothing is known as yet. It is impossible to believe that all of them are without commercial value. The investigators are faced with a difficulty even in regard to those trees which are now being exported. from the fact that these timbers are at present passing under their local names, and these names differ among the different native tribes It is not yet possible to say whether all of these are the same timber. There are a number of separate species of West African mahogany, and one of the Institute's present tasks is that of trying to clear up the confusion which exists owing to these different native names and to find out precisely what each one means. This is of importance to the timber trade because as long as consignments are mixed the best prices will not be obtained.

CRICKET-BAT WILLOW.

A problem which has engaged the attention of the Institute nearer home is that of the cricket-bat willow. Until last year it was assumed that practically everything was known about this tree, but doubts were then raised by the experience of a certain grower who, after bringing to maturity 10,000 sets of cricket-bat willows, then found that they were rejected by buyers as unsuitable for making cricket-bats. Faced with a heavy loss, the grower appealed to the Institute, and Dr. J. Burtt Davy devoted a considerable amount of time during the past two years to investigating the matter. He found that in the original consignment there were as many as four distinct kinds of trees ; it was possible to discriminate between them only by a study of their botanical characteristics. In the course of the inquiry it was found that other growers had been confronted with the same problem, although on a smaller scale. This work is still being carried on with a view to discovering which of the four kinds of tree it is that produces really good bats, and whether the others can be put to any practical use.

Parties of students from the Institute during the year visited forests in Germany and Czechoslovakia, and during the summer another party carried out a special reconnaissance survey in the Jura and visited French and Swiss forests. Important work has also been done in the study of frost damage to trees ; a survey of Dutch elm disease was made and showed a

definite increase of the disease throughout England, although there occurred undoubted cases of stoppage of dieback and apparent recovery. There has also been begun a six years' programme of research into the heart rot of oak caused by *Stereum spadicium.*

The entomological side of the Institute's work has included the production of the forest insect film, *The Sirex Woodwasps and their Parasites,* shown for the first time at the London Pavilion on January 5. This film, produced in collaboration with British Instructional Films, Limited, was a preliminary attempt at making a film record of a forest insect's biology for educational purposes. The result has been sufficiently encouraging to warrant the consideration of producing other films of a similar nature. The research studies of the section include, among other things, investigations of the caterpillar outbreaks in the oak forests of the Forest of Dean and the injurious Pine Shoot Moth (*Evetria buoliana* Schiff) in Norfolk and Suffolk. In both cases the aim in view is to discover the nature of the forest conditions which favour the abnormal increase of these pests.

(*The Times.*)

Fig. A. Fig. B. Fig. C. Fig. D.

(Photo by Harswarup.)

ALSTONIA SCHOLARIS

Four seasons old from transplants showing stages of development of a straight axis.
Line No. 6, Comptt. No. 2, Expl. Garden, New Forest, Dehra Dun, U. P.

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THE MODE OF GROWTH OF ALSTONIA SCHOLARIS, R. Br.

BY H. G. CHAMPION, I.F.S.

Alstonia scholaris, as is well-known, is a widely distributed but not very common evergreen tree. It cannot be said to be important as the timber is not durable, though soft and easily worked. The tree is, however, decidedly handsome with its dark-green glossy leaves in whorls of 4 to 10, and it was for this reason that a few plants were raised to meet occasional requests for a quick growing evergreen for road side and garden planting. The seed used germinated very well, so that more stock was obtained than was needed for the original purpose; the surplus was used up trying routine planting methods on a small scale. The species proved exceptionally easy to handle and grows quickly and well.

The tree, as one sees it in the forest, usually has a tall and straight, if somewhat fluted and buttressed stem. The mode of branching of the young plants as shewn in Fig. A, Plate 7, is however peculiar, for terminal growth on the stem ceases entirely after a period, and four branches are developed axillary to the last whorl of leaves, radiating like the spokes of an umbrella turned inside out. One is left wondering how a straight axis can possibly be produced, especially as these branches may themselves repeat the same process (Fig. D, bottom branch on the left).

In due course, however, one or more buds appear below the terminal whorl of branches and curve up between the latter (Fig. B). Nearly all the growth is then diverted into the new

leader which soon equals and finally overtops the branch whorl (Fig. C). In turn, this new leader branches and comes to a stop (Fig. D), and so it goes on till the full normal height is attained. The basal bend of the successive new leaders is soon lost in the general diameter increment, and a straight axis results, actually built up sympodially from sections 1′-3′ long, each bearing 3-8 whorls of leaves, the axillary buds of which do not develop. Whilst sympodia are a common place in inflorescences, it is unusual to find them in the main axis of trees.

It may further be noted that the whorl of branches is often carried up a short distance above the parent whorl of leaves by intercalary growth and the new leader apparently develops from a dormant bud in the axil of one of the leaves (fallen by that time). The regularity with which the branches in a whorl number four, would suggest that there are only four true leaves in a whorl, the others being derived by sub-division or stipular development (much as is usually suggested for *Galium* and *Rubia*), but this is evidently not the explanation, though no other is easy to discern.

The query arises as to whether each whorl represents a year's growth and the answer to this appears to be, as with the familiar case of *Bombax*, that the correspondence is only a very rough one, though occasionally the agreement may be fairly close. Incidentally, *Bombax* produces its whorls of branches quite normally, retaining the same leader throughout its height growth unless it is njured and so replaced by a branch—usually with consequent crookedness.

AN EXPERIMENTAL STUDY OF THE THERMAL CAPACITY OF SOME FUEL WOODS.

By R. C. Malhotra.

Professor of Biology and Director of the Biological Laboratories, St. Mary's College, Saint Marys, Kansas, U. S. A.

While some aspects of the physiological and biochemical study of *Cedrus deodara* were in progress at this laboratory, a careful paper based on painstaking data obtained by Krishna and

Ramaswami (3)* of the Forest Research Institute, Dehra Dun, was brought to the attention of the writer. These authors were cautious enough to leave the explanation of their results an open one.

This problem, however, does not only concern the calorific value of the fuel wood as such, but also has a bearing on some physiological activities of the plant. Thus, it seemed worth while to inquire into this question from as many interacting factors as could be possible. The writer's data, in the main, agree with Krishna and Ramaswami's for the Indian woods as far as they go. However, there are too many factors involved, as ably pointed out by these workers, which may modify the calorific values. Thus it is justly felt that some additional data showing the divergent trend of such values may be of some interest, besides being helpful in the explanation invited by these authors.

Wood is chiefly composed of fibre and sap. The former mainly consists of cellulose $(C_6H_{10}O_5)_n$ and other nitrogenous and non-nitrogenous materials, "incrustating materials," which increase in the heartwood. The sap is a solution of various organic and inorganic substances. The carbon, hydrogen, oxygen and nitrogen analysis of various woods showed the following variations:—

Table I.—Composition of different woods. (Ash free):—

Kind of tree.	Percentage of			
	C.	H_2.	O_2.	N_2.
Maple	49·81	6·31	42·92	0·96
Oak	50·63	6·03	42·06	1·28
Willow	51·78	6·17	41·07	0·98
Pine	49·94	6·25	42·51	1·31

* The number in parenthesis refers to the corresponding number of the quotation recorded under "Literature Cited," which has been arranged alphabetically at the end of the article. For further details, the original citations may be referred to.

The ash content of the wood effects its calorific value. In general, the greater the ash, the lesser the calorific value. It is to be admitted that the trunk contains more heart wood than sap wood, while in the branch this relationship is just the reverse. Thus the ash content of several such woods was determined by completely burning the sample in an electric muffle. The following values were obtained :—

Table II.—Ash content of various trees :—

Kind of tree.	Trunk wood.	Branch wood.
Oak	1·94	1·49
Beech	0·73	1·54
Aspen	1·49	2·38
Willow	2·94	3·66

Not only does the ash content of the wood vary with the location of the tissue in the tree but also with the soil, as is shown by the following data :—

TABLE III.—Ash content of 3-year old apple trees (delicious variety) grown in various soils:—

Kind of Soil.	*Percentage of Ash.*
Sandy	2·93
Loam	3·06
Sandy-loam	2·98
Marsh	2·71
Black alkali	2·63
Clay	3·16

The calorific value, for a given volume and species of wood depends on the percentage of moisture. In general, the greater the moisture the lower the thermal capacity of the wood (other conditions remaining the same). The moisture content of a tree

varies with the season, as is shown below for several naturally grown trees:—

TABLE IV.—Data showing moisture content:—

Kind of tree.	Percentage of moisture in	
	Winter (January).	Spring (April).
Maple	29·0	38·6
Ash	33·6	40·3
Horse Chestnut ...	40·0	48·0
Fir	46·5	55·8
Red Pine	47·0	56·3

Furthermore, the moisture content of different tissues of the same plant varies, as the following data may show:—

TABLE V.—Moisture content of Apple (Delicious) on June 2nd 1931 —

Tissue.	*Percentage of Water.*
Leaf	86·3
Buds	50·1
1 year old twig	37·9
2 „ „ stem	32·2
3 „ „ branch	31·7
10 „ „ limb	23·6

It is a well-known fact, that by drying, the volume of the wood is decreased, by moistening increased. For drying wood, perfectly high temperatures are essential, yet on air-drying the same wood readily absorbs more hygroscopic moisture at higher than at lower temperatures. On the whole, more water is absorbed

in winter than in summer, assuming the same relative humidity of the air. Thus, under these conditions, air drying may not represent comparative figures. The following data illustrates this fact:—

TABLE VI.—Loss and gain of moisture at various temperatures (December 11, 1930):—

Temperatures in Centigrade degrees.	Percentage of Water given off in		Percentage of Water absorbed on air drying in	
	Oak.	Walnut.	Oak.	Walnut.
125	32·8	30·9	11·7	10·3
150	33·2	31·6	11·9	11·0
175	35·9	33·7	13·2	12·2
200	42·9	41·7	15·4	14·6
225	48·8	47·2	18·4	16·9

Thus it would seem that perfect drying is poor for fuel value. Best wood for the purpose may be obtained by air drying.

As pointed out before, the fuel value of a wood depends chiefly on the cellulose content (2) and on the resinous material. Ordinarily one would assume that, since all types of celluloses have the same formula $(C_6 H_{10} O_6)_n$ and the same percentage of carbon (44·44), hydrogen (6·17) and oxygen (49·39), their thermal capacity must be the same. Legg (4) from Sheffield even questions the chemical uniformity and individuality of cellulose. The writer purified celluloses from various sources. Their thermal capacity per kilogram was determined by Parr—Oxygen bomb calorimeter, recently developed by the Central Scientific Company. Corrections for the fused wire and nitrogen were made.

The net values have been presented in the table below.

TABLE VII.—Calorific values of various types of cellulose per Kilogram) :—

Source.	*Gram Calories.*
Purified cotton	4190
From paper	4151
From birch	4208
From fir	4168
From linden	4102

The presence of resinous substances accounts for the higher fuel values of fuel. It is probably true that there is a variation in the thermal capacity of the wood because of the constitutional difference of the cellulose, yet the significant calorific increase may be due to resinous, oily or waxy substances. At least such a tendency appears from the data presented below. These woods were all of the same age (6 years).

TABLE VIII.—Thermal capacity of various woods :—

Name of Tree.	Gram Calories.	Remarks.
*Fir	5038	*Contains resinous substances.
*Pine (Jack) ...	5085	
Oak	4625	
Beech	4774	
Ash	4710	
Elm	4728	

Such findings, for the most part, agree with those of Poole (5). The heat values of the sap and the heartwoods are not uniform. In the majority of cases, the heart wood shows more thermal capacity than the sapwood, while in some cases, the reverse may be true, while still in others the value may be about equal, as can be ascertained by the data presented in table 9.

TABLE IX.—Calorific values of heart and sap wood of some American trees :—

Name of tree.	Heart wood calories.	Sap wood calories.
Pine	5009	4918
Red Beech ...	4993	4819
Birch	4981	4907
Pitch Pine ...	4939	4963
Ash	4836	4702
Maple	4901	4975
Elm	4985	4793
Fir	4822	4763
Linden	4896	4881
Poplar	4852	4897
Willow	4563	4401

Krishna *et al.*, think that the possible explanation for the high calorific value for the sapwood may be found in the manner of the storage of the reserve materials during certain seasons of the year, although they wisely did not support it strongly. The present writer obtained similar woods in fall and summer (presumably the consuming and storing seasons of the food reserves). He could not find a difference more than ± 70 calories. Even then the same general tendency of the respective values was shown as expressed in table 9. Palladin's evidence, as presented by these authors (originally written in 1916), has been greatly

modified since then. It is generally recognised that the substances are accumulated in the root for winter storage or the lower trunk, from which they are transported, not for storage, but for consumption by various tissues. Thus apparently not much chance of their increase may be possible.

Assuming the substances were stored in the upper portions of the wood in winter, such has not been shown experimentally for the trees other than those grown in the temperate regions. Although there are probably two short rest periods in most Indian trees, except those grown in the north, differential calorific values have, in some cases, been shown even by the trees grown in subtropical India. Its indirect evidence has been presented by several contributions of Professor Inamdar and his co-workers. Another evidence to the same effect has been obtained in the writer's laboratories. The MSS is being revised to be submitted to the Royal Society in the near future.

These authors have assumed, at least theoretically, that the higher calorific values of sapwood may be due to the wood parenchyma. It seems fruitless to look for the explanation in this direction, because *(a)* such cells in sapwood have very thin walls, while similar cells in the older wood have more stratified thickening, hence more carbohydrate material, as physical and chemical analysis of Sponsler (7) and Rilter's (6) studies have shown ; *(b)* the living parenchyma cells of this region, in the main, contain more sap and mineral materials, since trachea and its governing cells carry up only mineral substances of the soil. Curtis and Dixon's controversies have cleared this field. These minerals have no (or very small) heat capacity. On the other hand, heartwood parenchyma accumulate more organic substances (tannins and so on) which have comparatively more calorific value. Indirect evidence has been given by Wakesman and Stevand (8) also.

The present writer is of the opinion that higher and lower calorific values for various woods may depend on (1) the relative proportion and quality of the summer and spring wood, which in consequence may be influenced by the sum total effect of the

environment of a particular year, (2) relative amount of the length of fibre development, which may depend on the sliding forces, or (3) on the relative ash content. These are very tentative schemes but an accurate study is being made to prove or disprove one or all of the assumptions stated. The data obtained by Aldaba (1) and Wisselingh (9) already suggest these possibilities.

It is a pleasure to acknowledge the help rendered by Mr. Ray Glynn, Assistant, Biology Department, of this institution.

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(5) Poole, H. "The calorific power of fuels". 1900, Chapman and Hall, London.

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NEW INDIAN SPECIES OF FOREST IMPORTANCE.

Part 8.

(*Continued from the "Indian Forester", Vol. LVI,* 1930, *pp.* 425 *to* 439.)

The present list of New Indian Species of Forest Importance enumerates 133 species and, as 965 have already been included in the previous parts of this list, the total is now 1,098.

This list not only includes species described since October 1930, but also many others which were omitted from the previous lists by oversight.

1. **Acalypha siamensis**, Oliver ex Gage, *Euphorbiaceae* (Rec. Bot. Surv. Ind., IX, p. 238), Tenasserim, Burma.

Allophylus longipes, Radalk; *Sapindaceae* (Kew Bull., 1931, p. 282), Garo Hills, Assam.

Alysicarpus meeboldii, Schindl., *Leguminosae* (Fedde, Repert., XXI, p. 13), Kashmir; Etawah, U. P.

Aquilaria khasiana, H. Hallier, *Thymeliaceae* (Meded. Herb. Leid., No. 44, p. 18 (1922) Khasia.

5. **Arundinaria gracilis**, Blanchard in Revue Horticole, (1886) p. 490, *Bambuseae* (E. G. Camus, Bambuseae (1913) p. 38), Himalaya.

Asparagus deltae, Blatter, *Liliaceae* (Journ. Ind. Bot. Soc., VI, p. 70), Gholam in the Indus delta.

A. gharoensis, Blatter, *Liliaceae* (L. c., p. 70), Gharo in the Indus delta.

Baliospermum meeboldii, Pax and K. Hoffm., *Euphorbiaceae* (Das Pflanzenreich, Heft 63, p. 414), Manipur.

B. suffruticosum, Pax and K. Hoffm., *Euphorbiaceae* (l. c., p. 414), Manipur.

10. **Bauhinia prainiana**, Craib, *Leguminosae* (Kew Bull., 1924, p. 93), Burma.

Berberis collettii, C.K. Schneider, *Berberidaceae* (Osterr. Bot. Zeitschner, (1918) LXVII, p. 140), Burma.

B. hypokerina, Airyshaw, *Berberidaceae* (Kew Bull., 1930, p. 208), N. E. Upper Burma.

Bridelia scandens, Gehrm; *Euphorbiaceae* (Gamble's Fl. Madras, p. 1281), W. Ghats.

Buddleia acutifolia, C. H. Wright; *Loganiaceae* (Kew Bull. 1930, p. 203), Bhutan; Burma.

15. **B. griffithii**, Marquand, *Loganiaceae* (l.c., p. 194), E. Bengal; Bhutan.

B. hookeri, Marquand, *Loganiaceae* (l.c., p. 191), Sikkim; Frontier of Burma and Tibet.

B. longifolia, Gagnep.; *Loganiaceae* (l.c., p. 189), N. E. Upper Burma.

B. myriantha, Diels; *Loganiaceae* (l.c., p. 203), Upper Burma.

Camphora decaisnii, Lukmanoff, *Lauraceae* [Nomencl, Iconogr. Cannell. Camphr., p. 23 (1889)], Ind. or.

20. **C. griffithii**, Lukmanoff, *Lauraceae* (.lc., p. 22), Bengal.

C. himalayica, Lukmanoff, *Lauraceae* (l.c., p. 23), Himalaya.

C. hookeri, Lukmanoff, *Lauraceae* (l.c., p. 23), Ind. or.

C. jussieui, Lukmanoff, *Lauraceae* (l.c., p. 23), Bengal.

C. thomsonii, Lukmanoff, *Lauraceae* (l.c., p. 24), Ind. or.

25. **Caragana spinosissima**, Blatter, *Leguminosae* (Journ. Ind. Bot. Soc., IX, p. 205), N. Waziristan.

Ceropegia hispida, Blatter and Mc. Cann, *Asclepiadaceae* (Journ. Bom. Nat. Hist. Soc., XXXV, p. 409), W. Ghats.

Cinnamomum andersonii, Lukmanoff, *Lauraceae* [Nomencl. Iconogr. Canell. Camphr., p. 7 (1889)], Ind. or.

C. angustifolium, Lukmanoff, *Lauraceae* (l.c., p. 17), Khasia.

C. assamicum, Lukmanoff, *Lauraceae* (l.c., p. 11), Assam.

30. **C. aubletii**, Lukmanoff, *Lauraceae* (l.c., p. 14), Burma.

C. blumei, Lukmanoff, *Lauraceae* (l.c., p. 7), Malabar.

C. brownei, Lukmanoff, *Lauraceae* (l.c., p. 7), Ind. or.

C. bureaui, Lukmanoff, *Lauraceae* (l.c., p. 12), Sylhet.

C. carrierii, Lukmanoff, *Lauraceae* (l.c., p. 14), Khasia,

35. **C. decaisnii**, Lukmanoff, *Lauraceae* (l.c., p. 6), Assam.
C. donii, Lukmanoff, *Lauraceae* (l.c., p. 15), Ind. or.
C. helferii, Lukmanoff, *Lauraceae* (l.c., p. 15), Andaman Is.; Tenasserim.
C. hookeri, Lukmanoff, *Lauraceae* (l.c., p. 10), Sikkim.
C. jacquemontii, Lukmanoff, *Lauraceae* (l.c., p. 13), Ind. or.
40. **C. jussieui**, Lukmanoff, *Lauraceae* (l.c., p. 10), Nepal.
C. lindenii, Lukmanoff, *Lauraceae* (l.c., p. 14), Himalaya.
C. luddemannii, Lukmanoff, *Lauraceae* (l.c., p. 12), Bengal.
C. luebbersii, Lukmanoff, *Lauraceae* (l.c., p. 18) Himalaya.
C. malabathricum, Lukmanoff, *Lauraceae* (l.c., p. 8). Malabar.
45. **C. morrenii**, Lukmanoff, *Lauraceae* (l.c., p. 17), Ind. or.
C. neesii, Lukmanoff, *Lauraceae* (l.c., p. 13), Sikkim
C. neumannii, Lukmanoff, *Lauraceae*, (l.c., p. 14), Ind. or.
C. odoratum, Lukmanoff, *Lauraceae* (l.c., p. 10), Himalaya.
C. poissonii, Lukmanoff, *Lauraceae* (l.c., p. 13), Ind. or.
50. **C. rougierii**, Lukmanoff, *Lauraceae* (l.c., p. 7), Burma.
C. stracheyi, Lukmanoff, *Lauraceae* (l.c., p. 8), Himalaya.
C. thomsonii, Lukmanoff, *Lauraceae* (l.c., p. 9), Himalaya.
C. wallichii, Lukmanoff, *Lauraceae* (l.c., p. 11), Ind. or.
C. wightii. Lukmanoff, *Lauraceae* (l.c., p. 8), Ind. or.
55. **C. wiliamsii**, Lukmanoff, *Lauraceae* (l.c., p. 18), Ind. or
Coffea merguensis, Ridley, *Rubiaceae* (Journ. Fed. Mala. States, (1920), Mus. X, p. 96), Burma.
Cotoneaster cooperi, Marquand, *Rosaceae* (Hook. Ic., t. 3146), Bhutan.
Croton lacciferus, Linn.; *Euphorbiacea* (Gamble's Fl. Madras, p. 1315), W. Ghats.

Cryptocarya neilgherrensis, Meissn.; *Lauraceae* (l.c., p. 1219), W. Ghats.

60. **Daphniphyllum bengalense**, Rosenth., *Euphorbiaceae* (Das Pflanzenreich, Heft 68, p. 11), Naini Tal; E. Bengal.

D. chartaceum Rosenth., *Euphorbiaceae* (l.c., p. 11), Khasia; Assam.

D. nilgherrense, (Wt.) Rosenth., *Euphorbiaceae* (l.c., p. 7) Nilgiri; Travancore.

Diospyros brachiata, King & Gamble, var atra Fischer, *Ebenaceae* (Kew Bull., 1927, p. 314), Burma.

D. marmorata, R. N. Parker, *Ebenaceae* (Ind. For., 1931, p. 209), Andaman Is.

65. **Elaeocarpus dubius**, A. DC.; *Elaeocarpaceae* (Kew Bull., 1931, p. 282), Assam.

Endospermum chinense, Benth.; *Euphorbiaceae* (l.c., 1928, p. 335), Myitkyina dist., Burma.

Ervatamia caudata Gamble, *Apocynaceae* (l.c., 1921 p. 510), Anamali Hills, S. India.

Erythroxylum wallichii, O.E. Schultz, *Linaceae* (Das Pflanzenreich, Heft 29, p. 144), India.

Euonymus fusiformis, R. N. Parker, *Celastraceae* (Fedde, Repert., XXIX, p. 144), Tenasserim, Burma.

70. **E. rongchuensis**, Marq. & Shaw; *Celastraceae* (Kew Bull., 1930, p 239), Assam.

Euphorbia cattimondoo, W. Elliot; *Euphorbiaceae* (Gamble's, Fl. Madras, p. 1277), Deccan.

E. fimbriata, Heyne, *Euphorbiaceae* (l.c., p. 1274), Deccan.

Fagraea birmanica, Gandoger, *Loganiaceae* (Bull. Soc. Bot. France, (1918) LXV, p. 58 inclavi), Burma.

F. prainii, Gandoger, *Loganiaceae* (l.c., p. 58 inclavi), Assam.

75. **Gentiana membranacea**,, Marq., *Gentianaceae* (Kew Bull., 1931, p. 75), N.E. Upper Burma.

Glochidion pauciflorum, Gamble, *Euphorbiaceae*, (Gamble's Fl. Madras, p. 1307), W. Ghats.

G. sisparense, Gamble, *Euphorbiaceae* (l.c., p. 1307), Mt. Nilgiri.

Glycosmis parkinsonii, Tanaka, *Rutaceae* (Journ. Bot., LXVIII, p. 227), S. Tenasserim, Burma.

Gnetum contractum, Mgf., *Gnetaceae* (Bull. Jard. Bot Buitenzorg, Ser. iii, Vol. X, Liver 4 (1930), p. 470). S. India.

80. **G. oblongum**, Mgf., *Gnetaceae* (l.c., p. 471), Bengal.

Gordonia anomala, Spreng; *Ternstroemiaceae* (Kew Bull., 1928, p. 332), Burma.

Haloragis isomera, R. N. Parker, *Haloragae*, (Fedde' Repert., XXIX, p. 104), Tenasserim, Burma.

Hiptage malaiensis, Niedenzu, *Malpighiaceae* [Arb. Bot. Inst. Braunsberg, VI, p. 39 (1915], Tenasserim, Burma.

Jasminum wengeri, C.E.C. Fischer, *Oleaceae* (Kew Bull., 1931, p. 283), S. Lushai Hills, Assam.

85. **Justicia valida**, Ridl. var. glandulosa, Fischer., *Acanthaceae*, (l.c., 1927, p. 211), Burma.

Klemachloa, R. N. Parker, gen. nov. *Bambuseae* Ind. For., 1932, p. 7.).

K. detinens, R. N. Parker, *Bambuseae* (l.c., p. 7), Mergui dist., Burma.

Lasianthus glaberrimus, Ridl.; *Rubiaceae* (Kew Bull., 1931, p. 28), Mergui, Burma.

Ligustrum travancoricum, Gamble, *Oleaceae* (l.c., 1922, p. 119), Travancore.

Litsea floribunda, Gamble, *Lauraceae* (Gamble's Fl. Madras, p. 1238), W. Ghats.

90. **Lonicera himalayensis**, Gandoger, *Caprifoliaceae* (Bull. Soc. Bot. France, (1918) LXV, p. 32), Tehri-Garhwal.

Macaranga flexuosa, Wt.; *Euphorbiaceae* (Gamble's Fl. Madras, p. 1326), W. Ghats.

Microtropis filiformis, King; *Celastraceæ* (Kew Bull 1931, p. 27), Mergui, Burma.

M. scottii, R. N. Parker, *Celastraceae* (Fedde, Repert. XXIX, p. 104), Tenasserim, Burma.

Millettia nepalensis, R. N. Parker, *Leguminosae*, (Kew Bull., 1931, p. 42), W. Nepal.

95. **Neolitsea foliosa**, Gamble, *Laueaceae* (Gamble's Fl Madras, p. 1240), N. Circars.

N. scrabiculata, Gamble, *Lauraceae* (l.c., p. 1240), W. Ghats.

Orthosiphon glandulosus, Fischer, *Labiaceae* (Kew Bull., 1930, p. 240), Assam.

Ostodes prainii, Gandoger, *Euphorbiaceae* (Bull. Soc Bot. France, (1919) LXVI, p. 287), Assam.

Oxytenanthera hosseusii, Pilger in Fedde, Repert., iii, p. 116, *Bambuseae* (Ind. For., 1929, p. 613), Amherst, Burma.

100. **Paederia prainii**, Gandoger, *Rubiaceae* (Bull. Soc. Bot., France, (1918) LXV, p. 35), Assam.

Paramignya beddomei, Tanaka, *Rutaceae* (Journ. Bot., LXVIII, p. 230), Anamally.

Phoebe wightii, Meissn.; *Lauraceae* (Gamble's Fl. Madras, p. 1228), W. Ghats.

Phoenix andamanensis. Hort. ex W. Miller, J. G. Smith & Taylor, *Palmae* [L. H. Bailey, Standard Cycl. Hort., p. 2594 (1916)], Andaman Is.

Prunus leucophylla, Blatter, *Rosaceæ* (Journ. Ind. Bot. Soc., IX, p. 206), N. Waziristan.

105. **Polygonum myriophyllum**, H. Gross, *Polygonaceae* (Engler's, Bot. Jahr., XLIX, p. 345), Central India.

Psychotria rhinocerotis, Bl.; *Rubiaceae* (Kew Bull., 1931, p. 28), Burma.

Pyrus parvifolia, Blatter, *Rosaceae* (Journ. Ind. Bot. Soc., IX, p. 207), N. Waziristan.

Randia klossi, Ridl.; *Rubiaceae* (Kew Bull., 1931, p. 207), S. Tenasserim, Burma.

Rhododendron imberbe, Hutchinson, *Ericaceae* (Gard. Chron., LXXXIII, p. 213), Kumaon.

110. Rubus irritans, Focke, *Rosaceae* (Biblioth. Bot. (1911) LXXII, p. 192), Kashmir.

R. jacquemontii, O. Kuntze ex Cardot, *Rosaceae* (Bull. Mus. Hist. Nat. Paris, (1917) XXIII, p. 286), India.

R. khasianus, Cardot, *Rosaceae* [Lecomte, Not. Syst., III, p. 298 (1917)], Khasia.

Salix radinostachya, C. K. Schneider, *Salicaceae* [Sarg. Pl. Wils., III, p. 116 (1916)], Sikkim.

Solanum hispidum, Pers.; *Solanaceae* [B. L. Gupta's For. Fl. Chakrata, Dehra Dun and Saharanpur For. div., p. 350 (1928)], Naturalized in Mussoorie and Dehra Dun.

115. S. pseudocapsicum, Linn.; *Solanaceae.* (l.c., p. 351), Naturalized in the Dun.

Sonerila collina, R. N. Parker, *Melastomaceae,* (Kew Bull., 1931, p. 42), Mergui, Burma.

Spathichlamys, R. N. Parker, gen. nov., *Rubiaceae* (l. c. p. 42).

S. oblonga, R. N. Parker, *Rubiaceae* (l. c., p. 42), Burma.

Stephania branchyandra, Diels, *Menispermaceae* (Das Pflanzenreich, Heft 46, p. 275), Martban, Burma.

S. delavayi, Diels, *Menispermaceae* (l. c., p. 275), Shan Hills, Upper Burma.

120. Stephegyne birmanica, Gandoger, *Rubiaceae* (Bull. Soc. Bot. France, (1918) LXV, p. 35), Pegu, Burma.

Sterculia euosma, W. W. Smith ; *Sterculiaceae* (Kew Bull., 1931, p. 282), Assam.

Strobilanthes spathulatus, R.N. Parker, *Acanthaceae* (Fedde, Repert., XXIX, p. 105), Tenasserim, Burma.

Symplocos sukoei, C. E. C. Fischer, *Styracaceae* (Kew Bull., 1929, p. 315), Mergui, Burma.

Thunbergia wallichiana, Gandoger, *Acanthaceae* (Bull. Soc. Bot. France, (1919) LXVI, p. 220, inclavi), India.

125. **Tithonia diversifolia,** A. Gray; *Compositae* (Parker's For. Fl. Punjab, 1924, ed. 2, p. 298), Naturalized in the Sub-Himalayan tract near Dehra Dun and Bengal.

Toxocarpus beddomei, Gamble, *Asclepiadaceae* (Kew Bull., 1922, p. 119), Tinnevelly, S. India.

T. palghatensis, Gamble, *Asclepiadaceae* (l. c., p. 119), Malabar, S. India.

Ulmus brandisiana, C. K. Schneider, *Ulmaceae* (Sarg. Pl. Wils., (1916) iii, p. 252), Kumaon; Kashmir.

Vaccinium forrestii, Diels; *Vacciniaceae* (Kew Bull., 1930, p. 240), Mishmi, Delei Valley, Assam.

130. **Viscum birmanicum,** Gandoger, *Loranthaceae* (Bull. Soc. Bot. France, (1918) LXV, p. 33), Burma.

Vitis affine, Gagnep. ex Osmaston, *Vitaceae* (Osmaston's For. Fl. Kumaon, 1927, p. 119), Kumaon.

V. parkeri, Gagnep. ex Osmaston, *Vitaceae* (l. c., p. 120), Kumaon and throughout the Sub-Himalayan tract.

Xanthophyllum bombayanum, Chodat, *Polygalaceae* (Bull. Herb. Boiss., (1896), IV, p. 263), Bombay.

FOREST RESEARCH INSTITUTE,
DEHRA DUN. MUKAT BEHARI RAIZADA.
The 26th January, 1932.

THE TRAINING OF CANDIDATES AND PROBATIONERS FOR APPOINTMENT AS FOREST OFFICERS IN THE GOVERNMENT SERVICE.

(REPORT OF A COMMITTEE APPOINTED BY THE SECRETARY OF STATE FOR THE COLONIES.)

TO THE SECRETARY OF STATE FOR THE COLONIES.

SIR,—In May 1930, our Committee was appointed by you, in consultation with the Secretary of State for India and the

Forestry Commissioners, with the following terms of reference :—

"To consider and report on the training of candidates and probationers for appointment as Forest Officers in the Government Service."

Our Committee originally consisted of :—

Sir James Irvine, C.B.E., F.R.S., Principal of the University of St. Andrews (*Chairman*).

G. E. S. Cubitt, Esq., C.B.E., Late Conservator of Forests, Malaya.

Major R. D. Furse, D.S.O., Director of Recruitment (Colonial Service), Colonial Office.

Sir Thomas Middleton, K.C.I.E., K.B.E., C.B., Vice-Chairman, Development Commission.

Sir Roy Lister Robinson, O.B.E., Vice-Chairman and Technical Commissioner, Forestry Commission.

F. W. H. Smith, Esq., C.I.E., Assistant Secretary, India Office.

C. G. Trevor, Esq., Late Vice-Principal and Professor of Forestry, Dehra Dun, India.

In October 1930, Mr. Trevor resigned from the Committee on his appointment as Chief Conservator of Forests in the Punjab, and Sir Alexander Rodger, O.B.E., late Inspector-General of Forests, India, was appointed in his place.

INTRODUCTORY.

In the summer of 1930 we held preliminary meetings, at which we surveyed the questions referred to us for consideration and determined our procedure. In addition, an opportunity was afforded to some of our members to meet the Committee of the Colonial Office Conference, held in June and July of that year, to which had been referred the question of Forest Services and Research.

Arrangements were made for us to receive all available information shewing how far the existing methods of training forest officers had proved adequate. We have had access to the reports

of the Forestry Examining Boards which have examined candidates for the Colonial Forest Service for the last six years, and full information has been placed at our disposal regarding the quality and attainment of the students who have presented themselves in recent years as candidates for the Home and Colonial Forest Services.

Our examination of this material indicated certain further lines of investigation. It appeared to us that there were serious deficiences in the training of forest officers for the Government Services, and it was necessary for us to consider whether the unsatisfactory state of affairs was due to:—

(*a*) the lack of the appropriate intellectual qualities in men attracted to the study of forestry, in which case a solution might be found in schemes designed to recruit candidates of a superior intellectual type;

(*b*) the existence of unsuitable or ill-arranged curricula in the several University Schools of Forestry, in which case the remedy would lie in the hands of the University authorities concerned; or

(*c*) the possibility that the qualifications required from candidates for the Government Forest Services might be higher than the Universities could reasonably be expected to provide in a three-years' course.

After full consideration of the curricula and schemes of courses in the five University centres which provide a degree or diploma in forestry, we appointed a Sub-Committee to visit the Schools of Forestry at the Universities of Oxford, Cambridge, Aberdeen, Edinburgh, and Wales (Bangor). These visits took place during the autumn of 1930, and every facility was given to the members of the Sub-Committee to inspect the equipment and to obtain first-hand knowledge of the detailed working of the several Schools. Our thanks are due to the University authorities and to the teaching staffs for the help and courtesy extended to the members of our Sub-Committee.

These visits of inspection were supplemented later by interviews before the whole Committee in which oral evidence was

taken from respresentatives of the teaching or administrative staffs of each of the Universities concerned. In addition, we had the advantage of hearing evidence from Professor R. S. Troup, Director of the Imperial Forestry Institute. Mr. R. S. Pearson, Director of the Forest Products Research Laboratory, also appeared before us to give evidence on behalf of the Society of Foresters of Great Britain.

We have taken full advantage of the findings and recommendations of the Interdepartmental Committee which was appointed in 1920, under the chairmanship of Lord Clinton, to prepare a scheme for giving effect to the resolutions of the British Empire Forestry Conference, 1920, with regard to a central institution for training forest officers, and reference to the action taken on the report of that Committee (*vide* Cmd. 1166) will be found in later chapters of our report.

The report is divided into the following chapters :—

Chapter 1. History of Forestry Education in Great Britain.

Chapter 2. Recruitment for the Forest Services: Supply and Demand.

Chapter 3. The Forest Officer: His Work, Qualifications, and Training.

Chapter 4. Teaching in the Schools of Forestry.

Chapter 5. The Imperial Forestry Institute.

Chapter 6. Alternative Methods of Recruitment.

Chapter 7. Proposals for Improvements in Training.

Chapter 8. The Future of the Imperial Forestry Institute.

Chapter 9. Summary of Conclusions and Recommendations.

From 1865 till 1905, when Coopers Hill was closed, is the first period of forest training, and India was the most important country concerned.

From 1905 to 1914 the Colonial Office and the Home Government began to take more interest in the training of forest officers.

From 1919 until the institution of existing arrangements Great Britain and the Colonial Office were more concerned, and India gradually withdrew.

It is noted that the Government of India bore the greater part of the cost of educating forest probationers in Great Britain during the first period. Between 1910 and 1919 the Development Commissioners authorized capital grants in aid of forest education, on a considerable scale, for Oxford, Cambridge, Edinburgh and Aberdeen.

The Committee divides the Forest Departments which employ trained forest officers into six groups :—

(1) The Home Forest Service.

(2) The Colonial Forest Service.

(3) The Indian Forest Service.

(4) The Burma Forest Service.

(5) The Forest Services of the Self-Governing Dominions.

(6) The Forest Departments of Southern Rhodesia, the Sudan, British North Borneo and Sarawak.

It is estimated that the strength of the higher staffs of the first four were in 1930 :

(1) 55 (2) 178 (3) 320 (4) 16 and 91 officers of the I.F.S., these 91 are included in 320 under 3.

Chapter 3 is of such great interest that it seems advisable to quote a good deal of it.

I.—WORK OF THE FOREST OFFICER.

The duties which a forest officer will be called upon to perform will vary considerably according to the country in which he is serving, the stage of development which the forests have reached, and, of course, the position which he occupies in his own service.

So far as the Home Service is concerned, he is engaged, after a preliminary probationership, mainly, but not wholly, in work arising out of afforestation operations. This entails the examination and assessment of land for planting purposes, the lay-out of plantations (including roads and rides), planning and supervision of nursery and plantation operations, work in connection with the formation of forest workers' holdings, and a certain amount of general estate management. There is already some forest management in the wider sense and forest utilization, which will gradually grow

in relative importance. The work generally is intensive, calling for sound training, and it is also, in the hilly country, distinctly arduous. At the same time the forest officer in Great Britain has at his disposal the resources of modern civilization, including easy means of transport.

The conditions under which the overseas forester lives and works may be very different. In place of small carefully mapped areas, he may often have to deal with very large, scattered and even undefined forests. In place of well-trained and disciplined subordinates he may have to deal with a staff which requires close and constant supervision. Instead of being able to travel by motor, train, or steamer, he will often have to find his way about on foot, sometimes with unreliable guides, and sometimes with very inadequate means of carrying his baggage. Instead of having a comfortable house to live in and ample supplies, he will find himself compelled to carry with him tents, furniture, and supplies of every kind. The qualities of self-reliance and endurance will be constantly called upon to overcome the difficulties encountered by the officer working under tropical conditions.

In certain cases the recruit may be fortunate enough to spend a few months, or even a year or two, in the company and under the guidance of a senior officer, but he may find himself almost at once in the jungle, with no one to help him except an interpreter and a few partially-trained subordinates.

When an officer is attached to one of the younger services the acquisition, settlement, and demarcation of Government Forest Estates may be an important part of his duties at an early stage of his career. This will bring him into close contact with the lives of the people and will necessitate a knowledge of forest law. The alignment and construction of roads and bridges and the design and erection of forest rest-houses and subordinates' quarters may soon call into use his knowledge of surveying and engineering. From the beginning of his career he will find his forest botany essential, and when in due course he comes to prepare working plans he will find ample scope for a full equipment of forest knowledge. Later, in a more senior position, he may find himself in

charge of the management of large areas of forest and dealing with administrative as well as with technical problems, and, finally, with the larger questions of forest policy and economics.

II.—QUALIFICATIONS OF THE FOREST OFFICER.

Personal.

Physique and force of character are of the first importance whether the forest officer is to serve at home or overseas. A large proportion of the men recruited in this country will serve in the tropics, and the personal qualifications required of them are admirably summed up in the following extract from the report of Lord Lovat's Committee on Agricultural Research and Administration in the non-self-governing Dependencies (Cmd. 2825, pages 19—21):—

"41. In the first place, it is generally agreed that tropical conditions of life expose European officials to stresses that do not operate to the same extent in a temperate climate. The fundamental qualification for such an official is *mens sana in corpore sano.* He must, if possible, not only start fit, but be kept fit; in mind, nerves, and body. This is not merely a matter of medically rejecting the physically unfit. It is necessary also to try to select men whose temperament, tastes, and habits will help them.

"Experience shows that for this purpose men usually do best if they are of a confident, cheerful, and equable temperament; not easily exasperated or depressed; energetic and patient; and, when possible, gifted with a sense of humour. They should be of active bodily habits, with a taste for games, sport, natural history, or other pursuits, such as will enable them to take regular hard exercise with pleasure. Without hard exercise men in hot countries rapidly lose their health, and often their mental serenity. The result is loss of efficiency and, in some cases, a tragic disaster.

"So much we think will meet with ready agreement from anyone who knows the conditions under which these men must live and work. But we wish to go further. We attach great importance to the possession of a strong and disciplined character, powers of initiative and self-reliance, imagination and sympathy, a keen sense of justice, observation and tact in dealing with colleagues and subordinates, good presence, address, and manners.

"It must be remembered that agricultural officers have to deal with their colleagues in other branches of the Administration, and, in certain Colonies, with European settlers, or with white residents of old standing in the Colony. To be fully efficient their opinions on their own subject must carry full weight with men who often cannot appreciate the more technical aspects of the question under discussion. It will greatly assist them to command the necessary confidence, if they are, in other respects at any rate, the equals of the men with whom they are dealing.

"Still more important do we consider personality to be when the officer has to advise and instruct native chiefs and headmen. For natives, as is well-known have exceptional powers of intuitive observation. Like children, they instinctively 'size up' the man they are dealing with ; and this they do very quickly, and generally with accuracy. White officers of the right stamp win their confidence to a remarkable extent ; but the best technical advice is likely to be thrown away if they do not regard the giver of it as—to quote the words of a West African chieftain on this very point—'a chief in his own country.'

"For these reasons we consider it most important to select candidates of a good personal stamp . . . . particularly . . . . where the official's duties bring him into close personal contact with planters, settlers, and—especially in tropical Africa—with the natives themselves."

From the point of view of the Forest Services the physical aspect has perhaps not been adequately stressed in this extract. Members of our Committee have personal experience of the "tragic disaster" of sending to the tropics men, apparently in normal health, who have suffered from nerves or shell-shock. Also, the strain of a tropical life is likely to intensify defects of eyesight or hearing, and thus reduce the efficiency of an officer through no fault of his own. A candidate for tropical service must, therefore, not merely be a first-class life but should have had a first-class life history. It is important also that he should not be too old to learn, nor too young to accept responsibility. In the opinion of those qualified by their experience to judge, the limiting ages in normal cases should be of the order of 21 as a minimum and 25 as a maximum.

Technical.

From our description of a forest officer's duties it might be inferred that the first consideration in training a candidate for service overseas is to fit him for "bush work" involving very little real forestry, and indeed it has been suggested to us that something less than a full technical training will suffice in the case of men destined for those countries in which forestry is still in an elementary stage of development. Thus, they might dispense with training in the compilation of working plans or, alternatively, their general course might be largely educational in character, the vocational subjects being "pruned to the principles and general technique" supplemented by instruction in the type of work which they would initially have to perform on taking up their duties.

From those opinions we emphatically dissent, and it will be obvious that they represent a short-sighted view when consideration is given to what lies ahead. We can illustrate our contention by what has happened in one of the Colonial Services. Within the service of a single officer, a period of less than 30 years, the Federated Malay States built up a well-staffed forest department; they passed a forest enactment closely following the Burma model; they constituted nearly one-quarter of the whole country reserved forest; they made rapid progress with the detailed survey of the more important reserves on the scale of 4 inches to the mile, and made air surveys of about 300 square miles of very valuable mangrove swamps; they provided excellent houses for the superior and subordinate staff of about 900 men; they constructed more than 1,000 miles of graded paths through the forests; they did silvicultural work which has been considered worthy of study on the spot by forest officers not only from many parts of the Empire but also from foreign countries; they established a vernacular forest school for the training of subordinates, and a well-equipped laboratory for the testing and preservative treatment of timber; they began the erection of a forest research institute to include botanical, silvicultural, entomological, economic and chemical branches; they made valuable contributions to the literature of forestry; and, last but not least, they largely increased the forest revenue.

Such activities can be successfully planned and carried out only by a forest staff of all-round technical and administrative ability. This has, in fact, been the experience of the long-established Indian Service but it is important to note that events are taking a similar course in the Colonies and that development, as can be judged from the example of Malaya, is liable to be very rapid.

It is clear that, even if an officer joins a department when its forest policy is still at an elementary stage and remains in it for the whole of his service, he may still be called upon to deal with advanced problems in the later part of his career. Moreover, the Colonial Office Conference of 1930 endorsed the principle that the separate Colonial Services should be reorganized on a unified basis and the possibility of carrying this policy into effect is being actively

explored. Even should a completely unified Forest Service for the Colonial Empire prove impracticable, it is commonly agreed that the greatest possible measure of flexibility is most desirable, involving facilities for the interchange and transfer of officers from one Colony to another. It follows, therefore, that any officer entering any Colonial Forest Department in future should have a training which would fit him to take his place in any other, whether the duties were advanced or elementary.

In view, then, of the important duties which a forest officer may be called upon to perform, we consider that his initial technical equipment should be as complete as it can be made, due regard being paid, on the one hand, to the length and cost of the preliminary training, and, on the other, to the fact that once an officer has joined a service it becomes increasingly difficult to spare him for prolonged periods of instruction.

In our opinion it is of the first importance to utilize the period of training for impressing on the mind of the future forest officer a complete picture, in outline, of his profession. We would not expect him on first appointment to be able to perform unaided the routine duties of the officer experienced in dealing with local problems, but we would expect him to display a professional outlook which would make him an apt pupil, and at the same time to display initiative and resource which would enable him to drive his way unaided through unforeseen difficulties.

In short, we hold that an officer's training should equip him for the whole range of the duties which may confront him during his service. Nothing less will, in our opinion, entitle him to the confidence of his Government or win for him the trust of his brother officers.

A comprehensive description is then given of the five Schools of Forestry at Oxford, Cambridge, Aberdeen, Edinburgh and Bangor, concluding with the following remarks.—

(1) The ground which the Schools of Forestry traverse in a three-year course cannot be adequately covered in the time. The student either gets too many lectures and is thus unduly

restricted in his private reading, or important work is inadequately treated, or both.

(2) A further year of study is obviously desirable, but the existing schemes whereby students at Cambridge and Edinburgh devote a fourth year at the University to specialization in a single branch of forestry fail to remove the deficiencies mentioned above.

(3) There are certain subjects, the teaching of which is more or less defective in all the schools excepting the special case of Oxford, which has the support of the Imperial Forestry Institute. We refer, especially, to forest engineering and working plans (in some measure also to tropical forestry), subjects in which forest-trained instructors are required. There are also subjects such as forest entomology and forest mycology in which the need for specialist teachers has become apparent, and forest economics and forest law which are important but nowhere receive adequate attention.

(4) The practical training is very unevenly dealt with in the different courses and in some cases definitely lacks organization. Lack of instructors to take charge of field parties and the cost of vacation work to the student have also presented difficulties.

(5) To bring all five schools up to the general level of efficiency which is required would entail a large outlay on equipment and, in particular, on additional staff.

After giving their reasons for believing that the post-graduate or fourth year training is at present rarely satisfactory the Committee state in paragraph 79 :—

Having regard to the small number of men to be trained, the greatest measure of efficiency combined with economy would undoubtedly be secured by concentrating all forest training at a single institution. There are, however, other factors besides economy and efficiency which must be taken into account. Consideration must be paid to local sentiment, to the cost of education, to the individual student, and to the fact that all the Universities concerned have incurred much trouble and expense to meet what

they believed to be a public need. Witnesses have impressed upon us the view that, if the number of Universities in which forestry is studied and taught were too drastically reduced, there might follow a loss of interest which would adversely affect recruitment. Finally, it has to be remembered that, apart from the training for a forestry degree, the University schools perform a useful function in providing less advanced instruction of value to those who will be engaged in agriculture and estate management. We feel, therefore, that to concentrate all training at one institution, though there are strong arguments in its favour, would not be practicable under existing conditions.

Chapter 9 may now be quoted in full :—

We may summarize our conclusions and recommendations as follows :—

(1) When the requirements of the Services are taken into consideration the courses of instruction in forestry now given in the Universities are not satisfactory, particularly in respect of field work ;

(2) A forest officer cannot be adequately trained in a course restricted to three years ;

(3) The cost of extending the forestry courses to four years in all the Universities concerned and of bringing each course up to the required standard would be prohibitive ;

(4) The Services offer the main opportunities for the employment of graduates in forestry but each year only 20 to 25 probationers are required. This demand is unlikely to be exceeded in the near future ;

(5) For the requirements of the Services it is unnecessary to have as many as five Schools of Forestry, and the provision of additional State aid in support of these Schools cannot be justified under existing conditions ;

(6) The standard attained by the candidates who present themselves for appointment to the Services affords evidence that recruitment is on too narrow a basis ;

(7) We recommend that in future the course of training should extend over four years, of which the first three only should be taken at one of the University Schools of Forestry, the final year being spent at the Imperial Forestry Institute;

(8) The University degree courses should be remodelled so as to concentrate the training on the fundamental aspects of forestry, as exemplified by European practice, omitting the more highly specialized branches of the subject;

(9) The Imperial Forestry Institute should be made responsible for instruction in the specialized subjects named in our Report, and should become a permanent and essential feature of the pre-Service training of forest officers;

(10) Provision should be made to facilitate the recruitment of candidates who have read for Honours in Arts or Science. This can best be secured by the institution of a scholarship scheme, the conditions of which should be kept as elastic as possible;

(11) We recommend that any University which desires to present candidates for the Forest Services should be required to maintain its instruction at a satisfactory level of efficiency, and we suggest the means by which this can be secured.

It will be seen that the Committee have gone very fully into the matter of forest training from the beginning, and their conclusions appear to be justified on the facts brought to their notice. They emphasize the splendid work done at the Imperial Forestry Institute at Oxford and recommend that it should now undertake the following work during the fourth or final year :—

(i) Forest policy, economics and law.

(ii) Tropical forestry and botany.

(iii) British silviculture (special problems).

(iv) Forest engineering.

(v) Advanced forest mycology and forest entomology.

(vi) Wood technology.

(vii) Forest soils.

Students should be required to select from the above list not less than six subjects, of which Nos. (i), (iv), (v), (vi), and (vii) should be compulsory.

The year at the Institute should include a further tour on the Continent to enlarge the probationer's experience of silvicultural systems and methods of management, and provision should be made for the inclusion of any further special work of a practical nature which might be required in individual cases.

We wish to add that in our opinion the number of lectures given at the Institute should continue to be restricted, and that particular attention should be given to guiding the reading of individual probationers. We emphasize the opinion that the courses should be adapted in individual cases to the particular Service which the probationer has in view.

The report of the Committee will certainly be of great value to the Government of India and Provincial Governments when at length the organisation of the forest department or departments is taken in hand. We may note especially that the Committee are emphatic on the need of a course of four years. This is somewhat different from the existing arrangements at the Forest College, Dehra Dun, and the whole report will well repay perusal by all who have the interests of the Indian Forest Department at heart.

EROSION—A COMPARISON BETWEEN TWO CATCHMENTS.

BY N. G. PRING, I.F.S.

In his most interesting article entitled Improved Control of Alluvial Rivers—(Erosion in the Punjab Himalaya)—Mr. G. M. Ryan raises some very important questions, some of which the following note attempts to answer.

The question of flood damage and its relationship to the denudation of the catchment is receiving a great deal of attention. One naturally inclines to the belief that a given amount of precipitation on an eroded surface gives not only a much more rapid run off but that a much greater quantity of silt is brought down

than is the case when an equal amount of precipitation falls on a similar area under forest. That the raising of alluvial river beds by silting is the cause of disastrous floods is a proven fact, but it must not be forgotten that such floods are consequent upon prolonged or heavy precipitation in the catchment, the bursting of dams, etc., and more rapid the run off the greater the damage. As a concrete instance the behaviour of two rivers, the Harro and its neighbour—the Sohan—during an exceptionally heavy and prolonged period of precipitation in August 1929, may prove of interest. The Harro destroyed or seriously damaged all its bridges except the main line railway bridge between Rawalpindi and Attock, while several of its tributaries damaged bridges. In addition, the Harro did much damage to riverain cultivation below Khanpur, in some instances arable stretches being replaced by pebble beach. On the other hand, no such devastation was caused by its neighbour the Sohan or the tributaries thereof. Both rivers rise in the mountain range which constitutes the Indus-Jhelum watershed, and they both contribute their water to the Indus, the former at a point just north of the Kalachitta Range and the latter some 60 miles further south and west. Let us deal separately with the catchment of both rivers as far as their junctions with the Grand Trunk road which crosses the Sohan at an approximate elevation of 1,400 ft. at a lesser distance and the Harro at an approximate elevation of 1,200 ft. at a greater distance from its source. The Sohan and its chief tributary, the Ling, receive their waters from the well forested hills of the Murree and Kahuta *tehsils*. Except for a sheet rock area comprising a few square miles near the source of the Ling and a few sparsely forested low hill areas the Sohan flows through well timbered catchments, where forest and cultivation alternate. The forests, which cover the greater area, occupy the steeper and also the colder aspects while villages and surrounding cultivation occupy warmer aspects and easier ground as a rule. The Sohan meets the North Western Railway at Sihala and the Grand Trunk road at an elevation of 1,400 ft. a few miles south-east of Rawalpindi. As far as this point, at any rate, the Sohan contains water all the year round and some of its tributaries

are perennial. The low lying land in the neighbourhood of Sihala is liable to inundation and there is a swampy area 5 miles north-east of Rawalpindi through which the Karang flows; floods in these areas must be accepted as normal phenomena. People who build their houses on flood land surely have themselves to blame if they are flooded out, and it is suggested that many of the bungalows in the Thames valley were better built on piles. During the Florida boom I remember reading that estate agents were selling for building purposes land that was inundated annually for several months of the year! During the heavy rains of August 1929 the Sohan and its tributaries came down in spate, but bridges remained intact and there was no untoward flood damage.

The Harro rises in the Galis north of Murree, some of its sources are more are less well forested, notably along the Murree-Nathia Gali road, a zone of forest stretches down one side of the range that divides the two main branches of the Harro and there is a low hill area fairly well forested with scrub species. On the other hand a large portion of the catchment is utterly devoid of woodland, notably a large area between Nagri and Lora, from Lora to Hulli, again between Kalabagh and Nara and along the range extending from a point north of Nara for 20 miles in a south westerly direction. Streams from the N. W. slope of this range cross the Harripur-Hasan Abdul road before joining the Harro and although generally dry they are liable to sudden spates. The barren range forming the Indus-Harro watershed is likewise an occasional contributory agent. The catchment of the Harro is higher than that of the Sohan. The Harro is snow-fed for a much longer period and yet its flow is much more variable than that of the Sohan. The fact that stretches of its bed are dry for long periods on end may be due partly to underground flow. There can be no shadow of doubt, however, that the reason for the disastrous floods of 1929 was due to the rapid run off from a catchment consisting largely of very poorly stocked grassland and denuded slopes. On these eroded uplands of the North West Frontier Province and on the Nahr plateau

wind may play a considerable part, during dry weather, in the shifting of soil which is subsequently transported as silt by rain and snow water. Aeolus is largely responsible for the silt brought down by the rivers in China; the writer hopes to study his activities as an eroding agent in the highlands of Baluchistan. A further comparative study of these two rivers during periods of heavy rainfall over the Murree Hills would prove interesting. Did the Harro bring down a greater quantity of silt than the Sohan? Judging by the eroded surface of the denuded sandstone below Kalabagh and the state of some of the barren catchments on either side of the Harripur-Hasan Abdul road the amount of silt broght down by the Harro must have been enormous. The following year the writer had the profitable experience of being shown round the Pabbi and was very much impressed by the rapidity with which the *bands*, formed for that very purpose, silted up. It is suggested that similar *bands* should be built for experimental purposes in denuded and forested areas for the purpose of determining the comparative amounts of silt brought down by precipitation. If it is proved that a much greater quantity of silt is brought down in the denuded areas, then forest denudation in the catchment must produce very serious effects in the alluvial plains. This effect would be particularly pronounced where the catchment consists of steep hills subject to extremes of climate as is the case in the Murree Hills and Gallis.

There is no reason to suppose that there is an increase of rainfall in this area. It is understood that an even higher flood than that of 1929 was recorded some years ago. Further east among the higher ranges it is not improbable that there is some—increase of precipitation, due to the irrigation of the plains, where by the contents of the Punjab rivers are spread over a very large area. The S. W. monsoon which blows during the hot weather and the intense evaporation are the chief factors that give rise to such phenomena. Observations taken from Kulu and Mandi show that, on days when the prevailing westerly wind blows, puff—like clouds form over the lower ranges shortly before noon These clouds pass over the outer ranges where disforestation and consequent radiation tend to decrease the rainfall, and bank along

some of the higher slopes, causing very frequent afternoon rain followed by clear skies in the evening. The higher reaches of Hurla valley and both sides of the range which forms the Hurla-Parbatti watershed benefit by this dry weather precipitation.

*NOTES ON LAC CULTIVATION IN THE HOSUR PLATEAU SALEM DISTRICT.

BY S. RANGASWAMI, RESEARCH RANGER.

These notes on lac cultivation are written in the hope that they may be of use to all Range Officers who are likely to start cultivation in their Ranges, in view of the fact that the Chief Conservator has issued orders that the work should be carried out as part of the territorial works. They are based on the writer's personal experience of lac cultivation for 2½ years in the North Salem Division, Madras Presidency. *The notes claim to have only a local application i.e., to the Hosur plateau.*

LOCALITIES SUITABLE FOR LAC CULTIVATION.

Places which are neither very hot nor very cold and where the annual rainfall is not less than 30 inches are suitable for lac cultivation. Moisture is an essential for the successful development of the insect.

Areas where lac is at present abundantly grown are generally over 1,000 feet above sea level and enjoy a fairly temperate climate. The annual rainfall is 30 to 60 inches.

Strong, dusty winds and heavy rain cause serious loss at critical periods of larval and male emergence. Insects are affected far more than we are and are unable to live a healthy life, or even live at all, outside their own particular limits of temperature and humidity. So, as a test of the suitability of an area for lac cultivation only a few trees should be inoculated in the beginning, and, if the lac flourished throughout the year on these trees, the opera-

* Mr. P. M. Glover, Entomologist at the Lac Research Institute, Nankum, has kindly read through the paper and given us the results of his more recent investigations. Where the views of Mr. Rangaswami appeared to be unfounded or unsupported by the wider experience at Nankum we have thought it desirable to make the necessary corrections in Mr. Rangaswami's text.—HON. ED.

tion may be extended on a commercial scale. Subject to the requisite climatic conditions the ideal area for lac cultivation should satisfy the following conditions :—

(1) Hosts should be plentiful and vigorous, (2) There should be no scarcity of labour.

TREES ON WHICH LAC IS GROWN.

There are several species of trees which support the lac insect. but the important ones are *Schleichera trijuga*, *Shorea talura* and *Zizyphus jujuba*.

Each strain of lac insect has its own favourite host plants, on which it thrives best for generations without any deterioration. On some, the insect can maintain itself, but does not grow to maturity. Some hosts help the insect to build up an appreciable quantity of resin, but do not reproduce a virile generation and others maintain the lac insects, but no appreciable quantity of resin is excreted. The ideal host is one which harmoniously promotes the four activities of the lac insects, *viz.*, maintenance, growth, secretion and reproduction. These notes deal with the cultivation on one of such species *i.e.*, *Shorea talura* on which the Mysore strain is cultivated.

The trees, if found growing crowded in groups, should be thinned out so as to let in more air and sunshine. The yield of lac from crowded trees has been found to be much less than from those situated in the open with plenty of light and air around them. Small and decrepid trees should be avoided and old trees should be coppiced so that they will be replaced by coppice growth.

Repeated and heavy inoculations eventually kill the trees. Heavy inoculation is admissible when the number of host trees is sufficiently large to allow of a rotation for their rest and recovery. Rest will restore the vitality of the trees and prolong their life.

CROPS.

The strain of insect we are dealing with, is called the Mysore brood and is the smallest but most prolific of lac insects, being

trivoltine in this district and having three life cycles during 13 months. Mysore is so far the only region where this phenomenon is known to occur. The three crops obtained are called Pre-monsoon, Monsoon, and Post-monsoon. The period of each crop has been as noted below :—

Year.	Name of crop.	Period.	
		Date of inoculation.	Date of swarming.
1927	Monsoon crop	13-7-27	20-11-27
	Post-monsoon	19-11-27 to 20-11-27	26-3-28
1928	Pre-monsoon	28-3-28 to 1-4-28	16-7-28
	Monsoon crop	18-7-28 to 25-7-28	23-11-28
	Post-monsoon	30-11-28 to 8-12-28	11-4-29 and 13-4-29
1929	Pre-monsoon	10-4-29 to 20-4-29	23-7-29 to 8-8-29
	Monsoon crop	28-7-29 to 11-8-29	25-11-29 to 9-12-29
	Post-monsoon	24-11-29 and 23-12-29	4-4-30 and 22-4-30
1930	Pre-monsoon Crop No. I ...	5-4-30 to 8-4-30	27-7-30
	Crop No. II ...	26-4-30	22-8-30
	Monsoon crop :—		
	Crop No. I ...	2-8-30 to 3-8-30	4-12-30
	Crop No. II...	25-8-30	12-1-31

Nutritional Requirement of the Insect.

A heavy crop of lac from an area of forest containing about 100 trees produces 5,000 lbs. of brood lac, and is said to remove from the soil 93 lbs. of nitrogen, 82-87 lbs. of phosphorous (P_2O_5), 62 lbs. of potash and 28 lbs. of lime. The continuous and heavy depletion of the inorganic constituents of the soil, if not adequately replenished from time to time, will prove disastrous both to the insect and the host plants.

Pruning.

The object of pruning of lac hosts is to facilitate the supply of the chief requirements of lac production by creating a framework of tender shoots. This framework is not easily obtained, but depends on the varying conditions of nutrition, age, vigour, food supply, temperature, humidity, and the depth and fertility of the soil. As very little literature is available on this subject, experiments were carried out in the *Shorea* areas of North Salem District from July 1927. Similar trees were selected and lopped every month in varying degrees of intensity *i.e.*, some trees were lopped of all their branches of 3 inches in diameter, some branches 3–6 inches in diameter, some from 6–9 inches and some from 9 inches upto about 15 inches. Pollarding and coppicing were also resorted to in the case of dying trees. The length and condition of the shoots obtained from various loppings were recorded frequently with the result that the trees lopped in July and August and again in November and December gave the best results. Pollarding and coppicing carried out in almost every month gave rise to good shoots, but this method should not be resorted to, unless the trees are old and decrepit and unfit for lopping, as otherwise the availability of the trees for inoculation will be minimised by such a procedure. The scheme now prepared for North Salem District for putting lac cultivation on a commercial basis, therefore, provides for pruning in the above 4 months only. The following points observed during the pruning operations are worth noting :—

(1) New shoots are seen usually on the upper side of a branch, rarely on the lower. They seem to come from cracks and

holes in the thick bark, mostly on forks, joints and where the dead shoots were.

(2) Shoots do not generally spring at cut ends.

(3) Branches growing perpendicular have fewer and smaller shoots closer to the cut end and some none at all.

(4) Branches which are slanting or horizontal have a larger number of shoots which are much larger and are more evenly distributed over the whole length, which conditions approximately approach the ideal.

(5) Branches between 3 inches to 8 inches in girth always have good and better shoots.

In the light of the above observations the following rules are framed for the guidance of those who carry out the lopping of *Shorea* trees for lac cultivation :—

(1) No tender shoots should be lopped.
(2) Branches of 6 inches girth are preferable for lopping.
(3) All dead branches and sticks should be removed.
(4) Lopping should be done about 6 inches above the fork to allow for the drying up of the cut ends and also to facilitate putting of brood bundles on the fork.
(5) All slanting or horizontal branches should be lopped as near the end as possible.
(6) Lopping should be complete.

I cannot definitely emphasise the last point, because by completely lopping the tree we are more or less putting an end to the functions of the root system, because the foliage, which is the store house for the photo-synthetic activity, is removed and there is no demand for the large quantity of food materials that can be absorbed and supplied by the root system. This opens the field for various experiments* to find out the best method of preparing the tree for inoculation, neither depriving it of its foliage nor mak-

* Extensive experiments have been conducted at the Lac Research Institute, Nankum, on methods of pruning. Mr. Glover, Entomologist, considers that lopping is not a satisfactory method of pruning, though it does give results, but is very hard on the tree.—HON. ED.

ing the roots functionless. The pruning will have to be regulated in accordance with the nature of the tree, for example, young vigorous trees should be pruned somewhat lightly and old trees rather heavily. All the pruned branches should be dressed with tar or cowdung. The object of lopping or pruning is not only to get a series of shoots, but also to prevent the plants from flowering and seeding, as a flowered tree has much less vitality than one which has not flowered. This is very essential in the Post-monsoon crop as the vegetative sap conducive to lac insects is not available and the reproductive sap is to be utilised for the growth of the insects.

BROOD OR SEED LAC.

The shoots should be from 2½ to 3 years of age when the reddish brown tinge of the tender shoots is changing to a whitish colour. Experiments were conducted in the cultivation of lac on tender shoots. The insects themselves do not like to settle on the tender shoots of reddish brown tinge. Probably the carbohydrates present are in the form of a mucilage unsuitable for the insects. The bark of the much older shoots is too thick for the proboscides of the insects to penetrate.

Cutting, selection and cleaning of brood lac:—

(1) Only healthy brood with good thick and continuous encrustation and numerous white filaments should be selected.

(2) All parasitised and immature lac encrustations and dried up portions should be carefully removed.

(3) Empty sticks should be removed by cutting as close to the encrustation as possible.

(4) Brood should not be cut until swarming is about to occur, the best results are obtained when it is cut immediately before actual emergence; where there is plenty of labour cutting may be delayed until the first larvæ are observed. Early cutting isolates the mother insect, and through her the larvæ, from their food-supply, and a swarm lacking in vitality may be produced.

Selection and cleaning of shoots for inoculation:—

This operation is very important as the quantity of brood is greatly minimised. The following rules should be observed:—

(1) All wiry and dead shoots should be removed.

(2) Shoots with dead ends or otherwise damaged by borers or other insect attacks should be rejected.

(3) Shoots with leaf fungus should also be rejected. This leaf fungus can be detected by black spots on the leaves. A cut section of a shoot will reveal if there is any borer or other attack inside. The presence of wood grains ejected by borers is also an indication of an unsound condition.

(4) Shoots with poor foliage should be rejected.

(5) A tall tree is much better than a stunted one, because the root system, which is representative of the crown, will be able to take food from a greater depth and area and supply the tree and its parasites—the lac insects.

(6) Light and aëration are also necessary for successful cultivation; wherever the leaves are crowded in a shoot it is an advantage to remove a few of the leaves.

(7) Shoots from the main trunk are preferable to shoots from branches, as the rising sap is easily available for such shoots.

(8) The shoots should not be too small or too close to the ground, especially in the Post-monsoon season, as the the radiated heat melts the resin and clogs the breathing pores.

(9) An inclined shoot is always better than a vertical one. This has been observed by me in almost every one of my crops.

The insect is entirely dependent upon its host not only for its food but also for the energy required to draw its nutrition from the region of food supply. Once it inserts its proboscis, the insect is fixed for life and makes use of the molecular forces of the plant to feed itself and the plant has to supply nutrition to the region of attack. The plant is therefore required not only to give food for the insects but also to meet the wasteful matter—honey—and it has also to contend with its own transpiration. Therefore a perfectly sound internal condition of the host is absolutely essential.

INOCULATION.

The cleaned brood lac should be cut into lengths of 8″ to a foot and tied into bundles of 3 to 4 sticks. Good and thickly

encrusted sticks of a foot in length may be kept without bundling. Aloe fibre should not be used fresh for bundling, as it appears to have a bad effect on the insects and, moreover, if the fibre is green, some of the insects settle on the fibre and are lost. Country twine obtained in shops comes in very useful and it can be used for 2 or 3 seasons, if proper care is taken.

Experiments have been carried out with various kinds of encrustation to work out the area covered by insects.

Four experiments were carried out, two in 1928 and two in the 1929 Pre-monsoon and Monsoon crops. The brood was divided into 3 classes as noted below :—

A CLASS :—Best brood, *i.e.*, good and continuous encrustation without any obvious parasite or predator attack.

B CLASS :—Good encrustation on one side of the stick, but with slight attack by predators.

C CLASS :—Discontinuous encrustation with predator and parasitic attack.

Representative sticks were selected from each kind of brood, and individual shoots of more or less the same height and girth and with the same amount of foliage in the same patch were selected and inoculated, the area covered by insects measured up and an average struck, the results of which are tabulated below. :—

Steps taken to ensure freedom from parasites and predators— The best sticks were selected and examined with a high power lens. They were removed after the emergence of insects and examined for the exit of predator moths. Those that had holes from which predators had emerged were rejected and the remaining sticks were kept under observation for a period of 2 months to see if there was any further emergence of moths. The area covered by insects on the particular plant on which the clean brood tested as explained above, alone, was taken into account. The box in which the sticks were kept was examined for the presence of Chalcids and none were found. Although these are only rough tests the brood was taken to be clean. The quantity of brood on different sticks was not however the same.

Name of crop.	Class of brood.	Length of encrustation in inches.	Area covered by insects in square inches.	Area covered for every inch of encrustation in square inches.
Pre-monsoon 1928...	A.	3½	195	56
	B.	3½	69	20
	C.	4	24	6
Monsoon crop 1928	A.	3	211½	70½
	B.	3	84	28
	C.	4	31½	8
Pre-monsoon 1929...	A.	4	212	53
	B.	4	82	20½
	C.	4	32	8
Monsoon crop 1929	A.	3	198	66
	B.	3	93	31
	C.	3	27	9

NOTE :—For want of facilities the experiment has not yet been repeated in a more accurate manner.

While doing the inoculation, the area available for the insects should be considered. Settlement takes place only on one side in the case of horizontal branches and on all sides in the case of vertical ones, and this point should be remembered in estimating the space required. Enough brood should be taken to fill the available space with insects. This work will be difficult to start

with, but by practice, it will automatically come in. The following points should be remembered during inoculation :—

(1). The bundles should be placed on forks in such a way as to touch all the suitable shoots.

(2). The upper ends of sticks should be in contact with the shoots as the insects always have a tendency to move upwards.

(3). Tying should always consist of $1\frac{1}{2}$ knots so that removal may be easy.

(4). A careful account of the number of bundles and sticks put on each tree should be kept to facilitate correct removal of the same later on.

(5). Small pieces which cannot be tied into bundles will have to be put in small bamboo baskets and hung up on suitable shoots.

Some writers advise inoculation with fairly big bundles and transfer them when the original shoots get full. This method I adopted in 4 seasons and the transferred shoots were almost all failures.

Therefore, it is a great advantage to regulate the quantity of brood rather than to effect transfers.

Swarming, Settlement and Removal of stick lac :—

As soon as the insect emerges from the body of the mother insect, it wanders along the shoots of the host trees until it finds a place ; where the bark is of a suitable succulence and thickness, inserts its proboscis and begins to suck the juices on the phloem ayer ; as soon as it begins to suck, it begins to secrete lac and form a protective cell for itself. The male and female cells differ in shape, the male cell being longer than it is broad, while the female cell is nearly spherical with a white dot.

As inoculation is carried on with the swarmed brood, settlement will be noticed on the same day. This goes on vigorously for 15 days, but from the 15th day onwards a few insects will still be coming out; but these insects are less healthy and may not survive. Moreover, the general emergence of predators and parasites is high at this time. So, it is very essential to remove the bundles from the trees as early as possible after the 15th day.

The loss of insects sustained by such removal is amply compensated for by the good and clean brood we get in the next crop. Settlement on nearly half the portion of suitable shoots may be considered sufficient and light inoculation is always preferable to an over heavy infection. Further, during the rainy season, when the pressure of sap is high, a given length of shoot can accommodate a larger number of insects than it does during the winter. Consequently heavily inoculated shoots during winter record a heavy mortality of the brood and the surviving insects build up only a small quantity of resin. One can, however, raise a more intensive crop during the rainy season. These are very important points to be noted in practical work, as great care and sound judgment have to be exercised in controlling the colonisation of larvæ on shoots during different seasons.

The inoculated shoots should be lifted up for examination by the leaves and never by holding the base of the shoots, as one is likely to crush the settled insects. The settlement is detected on the branches of big trees by their reddish appearance. The inoculated areas should be inspected almost daily for a fortnight to note any damage by rats, monkeys, etc., and to replace any fallen brood sticks in their place.

The bundles should be removed very carefully without damaging the settled insects.

Growth and Secretion.

After fixation on the twigs, there is usually a heavy mortality among the insects. The following appear to be the causes of such mortality :—

The larvæ that emerge towards the end of the swarming period usually die.

If the brood is cut prematurely, the greater is the percenage of mortality. Very little mortality is obtained when good vigorous brood that is about to swarm is put on the trees.

The female insects, after fixation, begin to produce the waxy and resinous matter "lac" as well as the sugary honey dew. This honey dew is a wasteful matter which is ascertained to be

1 C. Cm., for every two inches length of encrustation in a period of 3 hours. The amount of secretion till the time of male emergence, which takes place from 6 to 8 weeks after settlement, is small, but once fertilisation takes place the secretion increases.

The males emerge usually after from 6 to 8 weeks. The elongated cell in which the male is enclosed is intended to facilitate its movement and emergence. The cell is broken up by its hind portion which contains a spine like end and the insect wriggles backwards and forwards and comes out. Once the insect has emerged, it sits quiet for about 15 minutes, probably to get its skin hardened, and then begins its functional work. Fertilisation goes on only during sunlight, and the insect takes complete rest during the nights. As the male does not feed during this period, it does its functional work only for 2 days and on the 3rd day it dies of exhaustion.

The period of male emergence is from 7 to 8 weeks but the actual number of days for various crops is as follows:—

Name of crop.	No. of days.
Monsoon crop 1927.	62
Pre-monsoon	77
Post-monsoon 1928.	85
Monsoon crop 1928.	63
Post-monsoon	77

The duration of male emergence is from 20 days to a month and this is another critical period in the life of the insects. The males are delicate creatures and succumb easily to adverse conditions of weather and the attack of predators and parasites. All females should be fertilised. After fertilisation, the resin is secreted at a fast rate. The demand on the host plant at this time is tremendous and a heavy rain at this critical period is very essential. In 1927 Post-monsoon crop a heavy rain in February saved the crop which was almost a bumper one. The 1928 Post-monsoon crop was a failure for want of this timely rain.

The honey dew drips down and the lac produced during the first stage is small in amount and very transparent. The insect, however, now proceeds to moult *i.e.*, cast its skin, and in doing so loses its legs and all power of locomotion. It becomes a pear shaped sac, the head and the proboscis are at one end and at the other end is a spine, two breathing holes and the anus, and in another 7 to 8 week's time, the full development takes place.

The monsoon season yields the richest harvest of lac and the Post-monsoon the poorest.

The maturation of the eggs is indicated by the formation of orange spots on the incrustation. The larvæ usually emerge within a week or 10 days. The area should be inspected daily to note the swarming.

From my own experience in the field I consider that early cutting is extremely harmful and unless the brood is to be transported to places far distant, it is advantageous to cut the brood 2 or 3 days after actual emergence of the larvae.

SCRAPING AND STORING OF LAC.

If all, or part of the brood, is not required for inoculation purposes, it should be removed from the plantation, or if stored there, should be fumigated with carbon bisulphide at the rate of 1 oz. per 10 cubic feet air space to kill all parasites and predators in it.

Water immersion is of no value. The stick lac may then be taken out and scraped.

In the case of brood used for inoculation the stick lac, that is, the sticks bearing the encrustation after all the larvae have emerged, are removed from the infected trees. In so removing them care should be taken to go through the area tree by tree and see that all sticks and bundles are removed, as otherwise the stick lac also becomes the breeding places of predators and parasites. It will be a great advantage to cut the twine with which the bundles are tied with a knife tied on to a pole, from the ground alone; because the coolies who climb the trees to

untie the bundles rub themselves against or carelessly handle the inoculated shoots and so damage the insects.

The *Ari* lac, *i.e.*, the lac cut before emergence of larvæ, is wet and living and so should be dried very carefully by spreading it out in thin layers and raking it frequently, as otherwise it will ferment and block.

The stick lac should be scraped immediately after removal as otherwise the larvæ and pupæ of predators emerge as moths, which become a source of danger to the new crop on the trees.

Further, the stick lac also gets spoiled by the attack of other insects. The scraping is done by beating the encrustation with a wooden hammer and scraping the sticks with a pen knife. The scraped lac is then ground into uniform grains either in a Coffee grinder or in stone grinders. It is then winnowed and all bits of wood, bark, stone, sand, etc., are removed.

It is important to note that the lac should never be dried in the sun as the grains melt and form what is called agglutinated or blocky lac, which is useless commercially.

The cleaned lac now obtained, called unwashed grain lac (*kacha chaori*), is then soaked in water either in a stone or wooden tub for 12 to 24 hours. It is then taken out and washed. This is done usually by a cooly getting into the tub and trampling the lac with his feet. The operation is repeated until all the dye is extracted and the water becomes clear.

If the dye is to be collected, the crimson coloured solution is removed, mixed with a small quantity of calcium chloride and filtered through a thick cloth kept over a heap of sand. The sand absorbs all the water and the dye is left on the cloth as a thick layer, which is then taken out and dried in the shade.

The grain lac obtained after thorough washing is dried in the shade and graded by sieves of different meshes into large, small and fine grains which are called *Chaori*, *Karola* and *Molamma* respectively.

INOCULATION OF SHOREA BROOD ON OTHER SPECIES.

The species on which the transference was effected may be divided into 3 classes :—

(*a*). Species on which the insects thrived well and produced as great a yield as on the mother host.

These are :—

(1). *Atylosia albicans* :—During the 1929 monsoon crop, ½lb. of brood put on 10 *Atylosia albicans* yielded 5 lbs. *i.e.*, 10 times the seed. In the 1930 monsoon crop, ½lb. yielded 9½ lbs. The experiments are being continued.

(2). *Acacia sundra* :—During the 1930 monsoon crop, 9 lbs. of brood yielded 45 lbs. *i.e.*, 5 times. In some cases the encrustation was much thicker than on *Shorea*. Attempts are now being made to raise a separate strain on *Acacia sundra* alone.

(3). *Dichrostachys cinerea* :—Two pounds of brood yielded 5 lbs. in the Pre-monsoon crop of 1930, but on this species the plants were flooded with predators. Attempts made to separate a strain in the monsoon crop of 1930 also failed. Experiments are now proposed to be carried out in pot-culture.

(*b*). Species on which the insects thrive but no appreciable quantity of resin is produced :—

(1). *Pterolobium indicum.*
(2). *Bridelia retusa.*
(3). *Desmodium gyrans.*
(4). *Flemingia congesta.*
(5). *Acacia suma.*
(6). *Anona squamosa.*
(7). *Acacia farnesiana.*
(8). *Zizyphus jujuba.*
(9). *Butea superba,*
and
(10). *Rynchosia rufescens.*

(*c*). Species on which the insects failed to thrive :—

(1). *Cochlospermum gossypium.*
(2). *Odina wodier.*

(3). *Zizyphus xylopyra.*
(4). *Dalbergia paniculata.*
(5). *Phyllanthus emblica.*
(6). *Ficus arnotiana.*
(7). *Terminalia belerica.*
(8). *Mallotus philippinensis.*
(9). *Premna tomentosa.*
(10). *Eugenia jambolana.*
(11). *Vitex pubescens.*
(12). *Acacia pennata.*
(13). *Acacia intsia.*
(14). *Chloroxylon swietenia.*
(15). *Psidium guayava.*
(16). *Indigofera mysorensis.*

In conclusion, I wish to say that though lac is used in ever so many ways which are well-known to the readers, yet due to want of steady supply and abnormal fluctutation of market prices, the users are turning to artificial products which are supplied cheap and at a steady price, even though they are not as good as the genuine product. The only hope to maintain the industry, therefore, lies in the concentrated mass production by Government agency and flooding the market at normal prices.

(1) PROBLEME DER WALDERHALTUNG IN HIMALAYA.

By Prof. Dr. Ing. Franz Heske 1931.

(2) DIE FORSTWIRTSCHAFT IN HYDERABAD (DECCAN)

Mit Vorschlagen zer ihrer Weiterentwicklung.

By Dost Ali Khan, 1931.

(1) It is not very often that India receives mention in Continental publications. There are, in truth, very good grounds for the criticism that Central European Foresters are either ignorant of the fact that scientific forestry and forest research have existed for quite a long time outside their own group of countries, or else, dazzled by the brilliance of the great names of past decades they are aware of it, but actually ignore it. Possibly—nay probably—neither of the two publications under review will do anything to correct this regrettable situation, for both of them tend rather to stress a need which is apparent to every forest officer of Indian experience, for measures of protection or development, than to refer to past accomplishments and present work.

As many of us know, Dr. Heske visited Tehri State in the Garhwal Himalaya in 1928 at the invitation of his friend, the Maharajah, and made well founded proposals on the lines of our many hill working plans for the better management of the forests. It is obvious that he was at least as much impressed by the unceasing destruction still going on, as by the actual or potential productive value of the forests, and it is very interesting to read what flows from his pen when he lets it run unreservedly for the information of his fellow countrymen. In this brief notice we cannot do better than to translate an abstract from his concluding remarks. "In India, the forest is very often the mother and wet nurse of agriculture, which hangs on like a parasite. If agricultural methods do not improve, *i.e.*, if they are not rationalised and intensified, then with ever-increasing population, complete destruction of the forest is probable."

(2) Mr. Khan's paper is a thesis presented at Dresden for a doctorate, and is dedicated to Dr. Heske. There is a brief historical review of the development of forestry in India, largely

drawn from Prof. Stebbing's book, followed by a very brief survey for the Indian States. Turning to Hyderabad State, statistics are given shewing it to have forest over 11·3 per cent. of the total land area, but we doubt if European Foresters would pass the figure without qualification anent the proportion actually carrying woodland. Recommendations for the improvement of forest organisation and management follow and one can endorse the italicised conclusions that complicated methods of yield regulation should be avoided as far as possible and that notwithstanding the well-founded objections to it, there is a strong case for clear-felling systems in the types of forest with which he has to deal. We may express surprise that in proposals for training the personnel, there appears no hint even that something might be learnt in and from other parts of India where organised forestry has been practiced long enough to have produced results.—

H. G. C.

DE OPENING VAN HET NIENWE GEBOUW, VOOR HET BOSCHBOUWPROEFSTATION BUITENZORG, 1931.

It is not very long ago since H. E. the Viceroy and Governor General of India formally opened our new Forest Research Institute buildings at Dehra Dun. The volume before us, as far as our extremely limited acquaintance with the Dutch language enables us to learn, describes a closely comparable event in a neighbouring country, Java, where on the 20th July, 1931, H. E. the Governor-General Jhr. Mr. A. C. D. de Graeff, officially opened the new buildings of the Forest Research Institute of the Dutch East Indies. The occasion must have been extraordinarily like its Indian counterpart, even if the Buitenzorg Institute cannot boast a straight approach ¾ mile long from a pretentious gateway to a mighty pillared entrance and has but a small central belfry to compare with our two majestic domes.

There were speeches by the Chief Inspector of the Forest Service, Dr. H. Ten Oever, and by the Director of the Institute, Dr. Wind; and Dr. von Wulfing gives a record of the services of Prof. Dr. H. A. J. M. Beekman, who was the first Director,

when the Institute was founded in 1913, till his retirement in 1920: photographs of these three gentlemen are reproduced together with the usual staff photos, a general view of the building, and a plan of the latter.

The greater part of the book is taken up by original papers contributed by members of the staff covering the field dealt with at Dehra Dun by the *Silviculturist, Forest Botanist, Biochemist* and Wood Technologist. Teak studies naturally figure very largely, and there is an interesting comparison between its productivity and that of the leading European species (and sal) as brought out in the published yield tables. It appears that for younger ages, teak exceeds them all, but ultimately it falls behind spruce and silver fir, equalling beech which comes next. A good feature is an English or German summary for all these papers, the former language just predominating.

We congratulate our neighbours on their fine new quarters, and confidently expect to see evidence of the better facilities they will now have in the pages of our highly valued contemporary "Tectona" and their other publications.

H. G. C.

EXTRACTS.

THE ANATOMY OF A TREE.*

BY L. CHALK, M.A., D. PHIL., IMPERIAL FORESTRY INSTITUTE, OXFORD.

The paper is intended as a general account of wood to serve as a foundation for the other lectures of the series. The Forest Products Research Laboratory at Princes Risborough is engaged on studying wood anatomy with particular reference to wood preservation, and those who wish for this special application must be referred there.

The first point which it is wished to stress is that wood is not a homogeneous material, but has a complicated structure, because in the living tree it has to perform more functions than that of mechanical strength; and it should also be remembered that it has to perform them when saturated with water, and not in the dry condition in which we handle it as timber.

Most of the troubles we encounter when we use wood as a raw material are due to the fact that the requirements for which wood has been specialised do not coincide with our demands on it as a timber. A species which produces what we consider a fine timber may be inefficient as an organism.

* Paper read at a meeting of the British Wood Preserving Association on December 9.

Judged by the standard of ability to spread over the surface of the earth, trees may be less efficient than such lowly herbs as the groundsel and the vast quantity of energy and matter which goes to the building of the trunk might conceivably be more profitably employed for purposes of regeneration. There is some indication that the more primitive of the hardwood trees produce heavier timber than the more advanced types.

The stem of a tree has three main functions to perform. Firstly, it has to give mechanical rigidity, so that the crown can be supported high above the competing vegetation and so that it can resist the force of the wind. Secondly, it has to conduct water and small quantities of dissolved minerals from the roots to the leaves. Finally, it has to store the surplus products, which are brought down from the leaves in the phloem or inner bark. The development of individual cell types for these purposes has given rise to the enormous variety which we find in woods of different species ; but there are certain fundamental types of cell which can be distinguished in all of them.

The second point which it is wished to stress is that wood is essentially not of a porous structure. The vegetable cell, as opposed to the cell of animal tissues, is distinguished by having a continuous rigid wall all round it and, with the exception of one type of cell which is only met with in the hardwoods, a liquid passing from one cell to another has to pass through the wall. In larch, for example, the cells are not more than 4 or 5 milimetres long, so that water, in passing up the tree, has to pass through a wall every 3 or 4mm.

The storage of food is carried out by small rectangular cells, which must remain alive to carry out this function, as they have to change sugars into starch and fats for storage and then change them back again to a soluble form when needed. Part of this task is taken care of by the rays and part by vertical series of these cells. For the conduction of water and for mechanical rigidity the cells need not remain alive, and actually die a few weeks after they are formed.

The conduction of water through the cell wall is facilitated by a structure in the wall known as a pit. The young cell has only a thin plastic wall, which enables it to change its shape as it grows. When the final shape is reached the cell adds on strengthening layers of wall from the inside like a plasterer in a room, but it leaves certain spots unthickened. The cell next to it also leaves an unthickened place on the opposite side, and these together constitute a pit, Pits are therefore not holes in the wall, but thin places where only the original wall stretches across as a membrane. In its simplest form a pit consists of two round gaps in the wall leading to the thin original wall. This type of pit is characteristic of the food-storing cells.

For purposes of water conduction a more elaborate type of pit has been evolved, known as a bordered pit. This has a narrow mouth leading to

a saucer-like cavity. Across the cavity stretches the original wall, but this has a thickened patch in the middle which is slightly larger than the mouth of the pit. The membrane is elastic and the central pad, or torus, may be moved across and block up the mouth, in which position the pit is spoken of as "aspirated." The bordered pit is in this way capable of acting as a valve.

For mechanical strength pits are only a hindrance, but there must always be some pits to provide communication from cell to cell while these are alive and growing. In the strength-giving cells, therefore, one finds that the pits are few and small and are often without any valve-like action.

Photo-micrographs show the different types of pits and the types of cell which have been evolved for these different purposes, using larch and oak as types.

In the hardwoods a special type of water-conducting cell, known as the vessel, has been evolved. The individual cells, or vessel segments, stand one above the other in vertical rows, and the special point about them is that the end walls, where they join each other, are dissolved away, leaving a long hollow tube.

The valve-like action of the bordered pits has long been known to botanists and, until comparatively recently, it was thought to be impervious to solid particles and to gaseous bubbles. Prof. J. H. Bailey, however, demonstrated in 1916 that the part of the membrane outside the torus is pierced by numerous minute holes. It is probably through these holes that a preservative passes. The size of the holes, which are from one to three-thousandth of an inch in diameter, may be affected by pressure and by heat, with as corresponding effect on the rate of passage of a liquid. Bordered pits may become completely closed by the torus when a wood dries out, and they are more commonly found in this condition in heartwood than in sapwood. A consideration of the pitting in different woods may supply the clue to many of the anomalies in the absorption of a preservative by different woods, such as the easier penetration of summer wood in some softwoods.

The vessels in hardwoods serve as an obvious pathway for a preservative and in many cases act as such ; but, even so,. the preservative must penetrate to the other cells also to be effective, and the question of pitting is probably of importance here, too. Actually the vessels in the heartwood of many trees are blocked up by a bladder-like intrusion from the living cells surrounding them. These growths are known as tyloses and often completely close the vessel. In our common oak and in the American white oaks the vessels in the heartwood are so closed, but they are not in the red oaks.

The rays were at one time thought to be of considerable importance as paths for the penetration of preservatives, but of recent years this has been doubted. Mr. Rendle, of Princes Risborough, tells me that they are probably important as a means of assisting the outward movement of gases, and that this question of getting the air out of a piece of wood is possibly the limiting factor in trying to impregnate a dry timber with a preservative.

Another point which is probably of some importance is the nature of the cell wall. As I have mentioned, the wall of a cell is thickned by adding on layers from the inside. These layers differ chemically and optically, and three such are usually distinguished—the primary, secondary and tertiary The secondary is usually the thickest and most important from the mechanical point of view, but to reach it a preservative must presumably pass through the inner or tertiary layer. The latter varies very considerably in thickness in different woods, and may prove an important factor in impregnation.

In the brief survey given in this paper, only a few points on one aspect of the subject have been touched on; but it is hoped that sufficient has been said to show the importance of the minutest features and of aspects which at first sight appear to be of academic interest only. The post-war development of forestry in our Colonies has led to the collection of vast numbers of new timbers, particularly from the tropics, and this wealth of new material has introduced a host of new problems which still await solution and is proving of immense value in testing and revising our older conceptions.

The study of the anatomy of these woods will probably prove of great assistance in perfecting the scheme of classification used by systematic botanists—a point of great scientific interest which will probably prove to have a practical application in the search for substitutes for well-known timbers.

(*Timber Trades Journal*).

HARDWOOD SUPPLIES.

"Some difficulties in marketing Indian timbers" was the subject of a lecture delivered under the auspices of the Timber Trade Technical Education Committee, on Wednesday evening, at the London Chamber of Commerce by Mr. W. R. Jacob, late Conservator of Forests in Assam.

Colonel STUART S. MALLINSON, D.S.O., M.C., who occupied the chair, said he was particularly pleased to preside at that lecture, because it was in connection with Empire woods. There was no reason why 100 per cent. of the hardwoods used in this country should not come from within the Empire. A week ago he would have made that statement with some trepidation, but that was not the case now. Recently he made a statement to one of the most distinguished members of the trade—a gentleman who had the confidence of the hardwood section—to the effect that he saw no reason why all the hardwoods used in this country should not come from within the Empire, except American oak. His friend replied: "I will go further, and say that there is no reason why every piece of hardwood should not come from within the Empire, or Britain itself." American oak could be replaced by bringing over here shiploads of certain woods from India. It would appear that timber like oak was utilised because it had always been used. Why should not consumers in this country regard some

of the Empire woods, which were not known very well at the moment, as being suitable and satisfactory? He was convinced that, if those who had any influence in the trade were to advocate the use of Empire hardwoods, in 20 years' time, if not 100 per cent., something very near it would be used. His hope was that the trade would be enthusiastic and support the beautiful woods which came from within the Empire.

Mr. W. R. Jacob said that in preparing his lecture he had found it very hard to separate the points of difficulty arising out of the bringing of timbers to market, which were the chief concern of the forest officer, and those which more particularly affected the timber trade. The latter, as the distributor of the raw material, was essential to the forest officer, who, by the nature of his business, could not keep properly in touch with the demands of the markets, the sizes and kinds of timber required, and the quantities the market could absorb. Some years ago he was actively concerned in sending considerable quantities of timber to London from the Andaman Islands. He had also been engaged in Assam, where the cost of freight precluded any idea of export outside India. As far as he knew, no timbers from Assam had come to London in merchantable quantities. Up to a comparatively few years ago the Andaman Islands had been little exploited, considering the area, except for the extraction of large trees of a few of the most valuable species. Excluding the mangrove swamps and the coast forest, which incidentally contained one of the hardest timbers in the world, known locally as Andaman bullet-wood, the forests were divided into two distinct types—evergreen and deciduous. The former were found on the tops of the hills and in the valleys, and the latter on the slopes. The evergreen included the gurjan, of more than one species, and of which a considerable quantity had come to London. It was used for railway wagon construction, flooring blocks and other purposes.

In the deciduous forests, there was a considerable mixture of species, many of which had come to London. The best known was Andaman padauk. Others which had come to this market included one known as silver-grey wood, koko, Andaman pyinma, and a wood known as white mahogany. Gurjan grew very straight, often 80ft. or more to the first branch, with a comparatively small crown, commonly up to 3ft. or more in diameter at breast-height, while the bole had comparatively little taper. The trees were rarely unsound, and the timber had few knots. Padauk occasionally had a long trunk to the first branch, up to 70ft., but it was inclined to branch much lower—at 30 to 40ft. It sometimes grew to a large size, up to 5ft. diameter, but large trees were commonly unsound for a considerable height above the ground, and the tree itself was liable to grow crookedly, and frequently had large buttresses. The "silvergrey wood" grew generally fairly straight with a clean bole of 60ft. and the timber was usually sound, while koko and pyinma were both inclined to grow somewhat crooked. Ordinarily they were found up to 2½ft. diameter with clean boles of 50ft.; the timber on the whole was fairly sound. The "white

mahogany" grew to a very large size, and generally straight with a clean bole of 50 feet and a large crown. The timber was usually sound and free from knots.

Mr. Jacob then went on to refer to the difficulties experienced in obtaining timber from the Andaman forest. One of the chief was labour which, in former days, was mostly convict. Some years ago, however, it was decided as a general principle that convict labour should not be used to compete in the open market, and it was replaced with free labour. There was little or no suitable local labour, and the workers had to be recruited from India and Burma. In the Andamans scarcely any food was grown for human consumption, and rice, the staple food, had to be imported. Labour, food and all necessities had to be brought from India or Burma by mail steamer, and then transported by Forest Department craft. The extraction of the timber to the waterways was done almost entirely by elephants.

After the timber had been dragged to the seashore or waterway, the logs were formed into small rafts and towed, or taken by boat or lighter, to the steamer. One difficulty was that some of the most important timbers would not float, or would barely float, and were soon water-logged. Therefore, it was necessary to fell and raft timbers of species that were useless for sawing, but as they were light, they helped to float the other timbers. Sometimes, owing to bad weather the rafts of timber broke up, when it became necessary to scour the harbour for scantlings and planks. They could imagine the effect that had on the condition of the timber when it was placed soaking wet in a hot hold in the tropics. He thought the sending of wet sawn timber from the tropics had often given really good wood a poor name. In general, it was doubtful whether ordinary artificial methods of drying were suitable in the tropics, especially in the damper climates. Still it was possible, with care, to get the timber to a certain degree of dryness. It was very important, especially when voyages might be for a month or six weeks, that the timber should be placed in the hold in as dry a condition as possible. On the other hand, it might easily happen that timber was dried too much, with the result that it warped and split in a damp, hot hold. More research was required into the point, to ascertain the best degree of dryness which each timber required for a voyage. Another difficulty was to cut timber to the sizes required on the London market.

Following the lecture, which was illustrated by means of slides, a short discussion took place. Mr. E. H. B. Boulton (Cambridge University) suggested that the staffs employed in the forests were too small, and that more research work was necessary. If the Government Department concerned could give assistance in that direction, Empire wood might come to this market in greater quantities.

The Chairman, in proposing a vote of thanks to Mr. Jacob, said he hoped that in the next series of lectures addresses would be given on timbers which could be obtained from other parts of the Empire.

The resolution was carried, and a similar compliment was paid to the Chairman, on the proposition of Mr. Boulton.

(*Timber Trades Journal.*)

EXOTIC CONIFERS.

The Conifer Conference, which is being held by the Royal Horticultural Society in the lecture room of its hall in Greycoat-street, Westminster, opened yesterday afternoon, and will be continued to-day and to-morrow.

In a paper dealing with "The Influence of Exotic Conifers and Their Influence on Silviculture in the British Isles" Sir John Stirling-Maxwell said that partly because nature has endowed us with only one conifer of timber size, and partly because of the suitability of our climate for the cultivation of many of the finest exotic species, Britain has led Europe in the planting of exotic trees for timber production. The first newcomers hailed from Central Europe and the earliest large-scale experiment with an exotic conifer was made in the last quarter of the eighteenth century and the first quarter of the next by John Duke of Atholl, who planted extensive forests of larch on his Perthshire estates. Since then many other species have been planted, with the result that exotic conifers have not only now taken a permanent place in British forestry, but have effected within living memory a revolution in the work of foresters who have been brought up against a whole batch of new problems.

After referring to the European conifers, and dismissing those of Eastern America as being of little or no value for timber in our climate, he passed to the trees of the Pacific coast, such as the Douglas Fir (*Pseudotsuga Douglasii*), the Sitka Spruce (*Picea sitchensis*, the Grand Fir (*Abies grandis*), the Western Cedar (*Thuya plicata*), and the Western Hemlock (*Tsuga heterophylla*), all of which he considered to be first-class timber trees. Of these, the Douglas Fir and the Sitka Spruce were the most important. Owing to the attacks of an aphis and certain fungi, for the moment the Douglas Fir was out of favour, but no one could doubt that, used with ordinary prudence, it would prove one of the most valuable timber trees of this conntry. But for the forester the Sitka Spruce was really more important as its introduction had definitely extended the area which could be afforested at a profit, and in recent years it had been planted on a large scale. The tree had a wide natural distribution, and it was important to get seed of the right type, for some types were so susceptible to frost as to be scarcely worth growing. Seed from Queen Charlotte Islands and from Alaska had given good results. The Western Cedar (*Thuya plicata*), and the Western Hemlock (*Tsuga heterophylla*) which seemed destined to play a more important part in our woods than that hitherto assigned to it, both produce finer timber than any silver fir. The Redwood (*Sequoia sempervirens*) would appear to be the only really promising conifer which had not yet been tried by British foresters.

THE JAPANESE LARCH.

Among recent introductions from the Far East the tree of most interest to the forester was the Japanese Larch (*Larix leptolepis*). Though it had already been widely planted its value as an agent for bringing moorland under wood was not yet fully appreciated. The hybrid between the European and the Japanese Larch had proved an excellent forest tree, more vigorous than either parent, and its behaviour suggested that more crosses might with advantage be made among forest trees.

Professor Borthwick, in a paper dealing with diseases of conifers, pointed out that the method of combating disease lies in prevention rather than cure. There was abundant evidence to show that epidemics could be prevented by the cultivation of disease-resisting species and varieties, and by avoiding all those methods of cultivation which are likely to cause or produce predisposition to disease. Among other matters to which attention should be paid were the selection of suitable sites, care in nursery treatment and handling in planting, selection of suitable planting distance, early clearing away of competing vegetation, timely thinning and the maintenance of suitable density throughout the life of the crop, the provision of nurse trees, or later underplanting in the case of pure woods, or the original establishment of mixed crop.—(*The Times*).

"INSULITE" TERMITE-PROOF BOARD.

The depredations of termites—sometimes referred to as white ants—constitute one of the gravest problems that architects and builders have to face; the only fortunate aspect of the problem being that the activities of this pest are mainly confined to tropical and sub-tropical countries, which at least makes it possible to concentrate combative effort in a way that would be extremely difficult were termites indigenous to all countries and climates.

Although wood is their special objective, termites appear to be omnivorous, even shoe leather being devoured in an amazingly short space of time. An alarming feature of the insects' ravages in buildings is the insidious way in which it works, the inside of timbers being eaten away until practically all that remains is merely a hollow shell, which suddenly caves in. Comment on this was made by Mr. S. W. Backus, Vice-President of the Insulite Company, after an extensive tour in termite infested countries. "In all my travels," said Mr. Backus, "I have never seen damage so complete and downright nerve-racking as when I looked upon the results of the termite's activity. Nothing seemed to stop them when once they had begun their depredation. Buildings actually caved in, due to their under-structure being eaten away. Even the leather in a person's shoes was not immune."

The effect of this experience on Mr. Backus was that the Research Laboratory of the Insulite Company was set to work to discover, if possible,

a material that would prove effective against the termite whilst at the same time providing the well-known structural and insulating qualities of standard "Insulite." After considerable study of the habits, food and gastric system of termites, the Insulite Laboratory eventually turned over to the export department a sufficient quantity of what was confidently believed to be a termite-proof board, with which to erect a small building, on a site where it would be exposed to the insects' ravages. The location of this building was Singapore, Straits Settlements, and as far as was possible everything was done to encourage the termites to go ahead and do their worst. For eleven months, in a veritable termite stronghold, the building was left to whatever fate might befall it. At the end of that time the structure was dismantled and each board carefully examined for evidence of damage or intrusion by the pest. The result was as astonishing as it was gratifying. Quoting from the laboratory report. ...." There wasn't even a mark on it to demonstrate the visitation of this insect. It might just as well have been up in Alaska, where to date no record of termite invasion has been recorded." Since that time, buildings have been erected in other termite infested countries, with Insulite termite-proofed board as an integral part of their construction and with the same entirely satisfactory results. As far as it is humanly possible to judge, the Insulite Laboratory can reasonably claim to have produced an anti-termite material. Of lesser comparative importance to the foiling of the termite, yet gratifying in itself, is the fact that the Insulite termite-proofed board has proved entirely unaffected by torrential tropical rains and excessive humidity.

Whilst the termite's activities have in the past been associated almost entirely with tropical and sub-tropical countries it is significant of the insect's menacing enterprise that it is lately reported as having invaded in great numbers the southern half of the United States and even as far north as St. Louis and Kansas City, Missouri, and much damage has already been reported from these districts. It is therefore well to bear in mind that as the termite is apparently becoming "internationally minded" there is an antidote internationally available, and any Insulite distributor throughout the world will now be in a position to supply Insulite termite-proofed board, retaining the structural and insulating qualities of standard "Insulite," in sheets half inch and one inch thick, 4 feet wide and 6 feet to 12 feet long. It certainly looks as though the long and appallingly expensive career of the termite is at last to receive an effective check.

(Indian Engineering.)

DOMESTIC OCCURRENCES.

At Calcutta, on 28th January, 1932, to Ompi, wife of Mr. H. C. Khanna, Indian Forest Service, a son.

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A NEW WOOD PRESERVATIVE THE "FALKAMESAM" PROCESS.

BY F. J. POPHAM, F.I.C.

AND

S. KAMESAM, B. E. (MECH.) M. E. (HONS). A.M.I.E. (IND.).

Wood Preservation Section, Forest Research Institute.

It is now generally accepted that the extent and efficiency of timber utilisation in any country depends chiefly on proper forest conservation and on the preservation of non-durable timber by the most economic process available. India is no exception to this rule. On the contrary, the need for proper wood preservation is more abundantly evident in India than almost in any other country.

With the exception of fuel, the most profitable income derived from forests is from timber utilised for structural purposes.

When the prices of competitive materials like iron, steel, and reinforced concrete have fallen to about the lowest on record, the need for the cheapest wood preservative consistent with efficiency is apparent.

Before a wood preservative can be used for preserving timber for outside locations, especially in a country like India where there is a heavy and almost continuous downpour during the monsoon season in most localities, it must be efficiently fixed in the wood so that it cannot wash out leaving the wood unprotected ; it should not be volatile. Besides this important condition, it must be poisonous to wood destroying fungi and insects, in addition to being available in large quantities at a low price. Further, so that wood preservation with the antiseptic may be carried out on a commercial scale and for other reasons, it should have the least corrosive action on mild steel. There are various other conditions to be satisfied under special circumstances.

As far as available experimental and field data published in India and elsewhere go, and so far as wood destroying fungi and insects are concerned, arsenic appears to have a much higher toxicity for a unit of money than any other chemical substance, (that is not too dangerous to be handled) that is known today.

Many attempts, (some of them haphazard, some of them carefully worked out at great expense) have been made to utilise arsenic in some form or another for wood preservation purposes. The main defect has always been that the preparations have been washed out of the timber during the monsoons, and it has been recognised that any process which can fix the arsenic in timber will commend itself to the wood preserving industry.

A short review of what has been achieved in field tests with arsenic will illustrate the possibilities. Results over long periods are almost entirely confined to the Powell process.

In India, in moderately wet localities with an annual rainfall of 30"-50", sleepers have given an average life of 15 to 18 years. Some species have given less than this, but the rejections were all due to mechanical failure such as spike killing, rail cutting, excessive splitting or twisting. In drier localities, the same type of powellised sleepers have given a better average life of from 18 to 22 years. It must be noticed, however, that powellised sleepers laid down in wet localities like Bengal, have proved a complete or partial failure. On the data available, the correlation with rainfall is sufficiently close to justify the conclusion that the defect is due to leaching of the preservative.

The defects in the process as carried out are as follows :—

(1) As no pressure was used for Powell impregnation, the penetration of the toxic arsenic should have been confined practically to sapwood only.

(2) Arsenic injected according to the Powell process is by no means fixed in the wood.

(3) The sleepers were subjected to prolonged heating; worse than this they were kept immersed in an acid solution—as sugar has certainly no neutralising action on arsenious acid. The strength of the timber must have suffered to some extent.

(4) The spike holes were bored *after* the Powell treatment was completed, so that the spikes penetrated into the untreated heartwood where there could be no penetration of the arsenic and hence no protection to the contiguous fibres—which act, when undecayed, like cantilever springs.

In view of the above statements, it is clear that the most economical and effective process for wood preservation in India, especially in moderately wet, wet, or very wet localities, seems to be one using arsenic as the toxic pri ciple, provided it can be fixed in the wood efficiently.

One of the authors, Mr. S. Kamesam of the Forest Research Institute, Dehra Dun, working at the Mycological Laboratory in charge of Prof. R. Falck at Hann Munden in Germany, devoted his attention to the fixation of arsenic in timber as being the most economic advance to be made in the wood preservation industry. His efforts were successful and the " Falkamesam " process was evolved. The process is being patented, but, if accepted, can be used by the Government of India free of charge. The process costs about one-sixth of the creosote treatment and about one-fourth as much as the creosote-fuel oil treatment.

Besides exhaustive experiments by Mr. Kamesam in Germany, experiments have recently been conducted at the Forest Research Institute at Dehra Dun to verify the claims of " fixation."

These experiments were carried out with small wood blocks $2'' \times 1'' \times \frac{3}{4}''$ of five different typical Indian species using sapwood only, which, in general, absorbs and gives up antiseptic more easily than the more difficult permeable heartwood. Two of the species selected were conifers and the rest were " hardwoods."

The pieces, in each case, were treated under pressure with the " Falkamesam " preservative, in a 2 per cent. concentration of the preservative, and the amount of arsenic absorbed in each case was noted. They were dried in an oven, and the dry pieces were ready for the leaching treatment, which consisted of the pieces, two at a time, being shaken with 100 cc of distilled water in a shaking machine that was arranged to give, on the average, about 10,000 oscillations per hour. After 20,000 oscillations were completed, the pieces were allowed to soak in water in which the pieces were shaken for about 12 hours and then analysed for the arsenic washed out. The pieces were allowed to air dry for 2 or 3 days

and the process was repeated twice (except for the 12 hours' soaking after shaking), the arsenic washed out after 20,000 shakes being determined in each case.

The following table shows the results obtained with five typical Indian timbers using the "Falkamesam" preservative—as well as three other arsenic preservatives, including the Powell process with which field results are available in India, and the zinc-meta-arsenite process (patented about 6 years ago) which is growing in popularity in America, several million cubic feet of timber being treated with it annually.

Table showing the percentage of injected arsenic washed out from wood impregnated with different typical arsenic preservatives:—

Result of 60,000 *shakes.*

No.	Name of species of timber.	"Falkamesam."	Powell.	Z. M. A.	As 2°5
1	*Shorea robusta* ..	3	33	23	43
2	*Albizzia procera* ..	2	37	30	33
3	*Pinus longifolia* ..	2	61	61	36
4	*Abies pindrow* ..	1	27	40	47
5	*Terminalia tomentosa*	3	33	32	23
	Average ..	2%	38%	37%	37%

The above figures indicate the distinct superiority of the "Falkamesam" process over the others experimented with as regards arsenic fixation in wood. Even after 60,000 shakes, on the average over 95 per cent of the originally injected arsenic remained in the wood without being washed out.

Considering thes mall size of the wood pieces used in the experiments, judgment regarding the relative value of the preservative tested, based

on results obtained after 60,000 shakings, should appear to be quite reliable even for very wet localities when the preservatives are used with timber in structural sizes.

It is reasonable to expect in view of the experimental results with the new process and the Powell process, and of the field data available with the Powell process that the " Falkamesam " process will protect timber treated with it for about 25 years even in wet localities - and for a longer period in dry and moderately wet localities. A note of caution might perhaps be added that this estimate may not necessarily apply to treated timber placed at any depth in the ground. It may also be noted that the life of species of timber which have untreatable heartwood will be largely determined by the durability of the heartwood if seasoning or weathering cracks develop. This feature, however, is common to all antiseptics including creosote. Mould fungi have not been found to have any effect of practical significance on the strength of timber. In any case, if timber treated with the new preservative is meant to be placed at some depth in the ground, it may be given a butt treatment of creosote for the first few years, when the superimposed creosote treatment may be dispensed with, if results with experimental stakes without it are found to be successful—as can be confidently expected from past experience with other metallic salt preservatives. In conclusion, it may be noted that with species of timbers in which the heartwood is refractory to impregnation, a water soluble salt will perhaps stand a better chance of penetration than with oils. Our investigations have shown that the new preservative appears to be the most economical consistent with efficiency of all known wood preservatives, including creosote.

SAL AND ITS REGENERATION IN THE UNITED PROVINCES.

BY E. A. SMYTHIES, I.F.S.

1. So much has been written on the above subject during the last ten or twelve years that one almost apologises for referring to it again. But while reading through the voluminous articles and correspondence published in the "Indian Forester" and elsewhere during the past decade, what impressed me most forcibly was the astonishing number of false starts and of contradictory results and opinions recorded by careful and competent observers, which in itself demands some explanation. While analysing these contradictory results and opinions to try and arrive at some plausible explanation, an idea gradually evolved, a broad suggestion on the existence of sal forests in general and their regeneration in particular which seemed to me to explain many of the discrepancies, and many of the contradictory results seemed to fit into the general scheme in their right place. The idea is neither new nor original, it is described by Troup (1) in detail in his great work on the Silviculture of Indian Trees. I do, however, suggest that it is of far wider application than Troup ever imagined or anyone else has hitherto suggested. Before attempting to expand this idea, it will be useful to summarise very briefly the more important results and opinions that have been recorded in the past.

2. Let us start with the work of Hole (2), who with Troup shares the honour of being the pioneer of detailed and scientific study of sal ecology. His researches and experiments, stretching over ten years, 1909-1919, threw a flood of light on sal ecology. He proved the evil effects of bad soil aeration, raw humus, weed competition, and heavy shade; he indicated that sal seedlings in our existing forests would take 40 or 50 years to grow up, if they ever grew up at all, and he showed that established regeneration could be obtained in eight years with soil working, weeding and overhead light. But in his suggestions for future management (7) he rather over-emphasised the overhead light in strips, and in the practical large scale application of his strips the other factors were ignored and the strips failed everywhere.

3. The working plans (4) prepared in the United Provinces during 1921-25 were greatly influenced by Hole's work, and concentrated on opening of the canopy in seeding fellings, but again omitted the other vital factors, especially evergreen weed invasion. In the working circles

depending on advance growth and coppice the results were generally satisfactory, but elsewhere the results have been uniformly disappointing, and in the revisions of these working plans now in hand we are faced with the very difficult problem how to keep a sustained yield from the sal shelterwood standing over evergreen weeds stimulated to exuberance by increased light. I personally believe that for the better quality sal forests with evergreen undergrowth no form of felling or manipulation of the canopy—selection, group, strip, shelterwood or clearfelling—will by itself now guarantee us our natural sal seedling regeneration.

4. The question of strict fire protection or controlled burning has received much attention. In 1920 I wrote an unpublished note on the Haldwani sal forests, urging that we should regularly burn weed infested P. B. I. areas and was rather severely snubbed! However experiments were started in several divisions, which have led to most conflicting opinions. Reports from some divisions show that the results of controlled burning have been excellent and weeds have been greatly reduced, in others that the burning has had no result either way, in others again, that the burning has been positively harmful. The latter include Gorakhpur, Bahraich and Saharanpur, the former includes Haldwani, where Ford Robertson after preparing the working plan wrote an interesting note in the "Indian Forester" (8). It may here be noted that the unfavourable results are chiefly from areas with stiff clay soils or dry xerophitic conditions, and favourable results from moist fertile loams. The annual report for Bihar and Orissa 1928-29 confirms this. In Assam—Kamrup division Milroy (14) depends almost entirely on fire to get his sal regeneration, in Buxa (Bengal) Shebbeare (13) explains that controlled burning is abandoned as useless.

5. Deer damage is another factor that has been examined and has led to controversy. As early as 1923 research experiments in the United Provinces showed that deer were doing considerable damage to sal seedling and coppice regeneration. In 1929 I wrote an article in the "Indian Forester" (10) pointing out that deer were an appreciable factor which led to a letter from Champion (F. W.) (11) urging that deer damage was altogether negligible in Dehra Dun.

The vagaries of deer (chiefly sambhar) are undoubtedly peculiar. In Dehra Dun they are certainly not a vital factor in the P.B.I. areas of cut back suppressed advance growth. In Ramnagar under very similar

conditions, they allowed the first compartment to go through alright, and have completely ruined the last three or four compartments similarly treated alongside. In Pilibhit they allowed three coppice coupes to go through and have ruined the fourth and fifth. Apparently they *gradually* tumble to the fact that we are providing them with abundance of food! Even more susceptible than sal, however, are *haldu* (*Adina cordifolia*), *asna* (*Terminalia tomentosa*) and *sandan* (*Ougeinia dalbergioides*) to deer damage; in the submontane forests these can neither coppice nor regenerate from seed except inside a deer proof fence. In Banda, however, the numerous sambhar never appear to touch these three species (where regeneration is profuse), but prefer such harsh diet as *Nyctanthes arbor-tristis* and any teak cuttings we may plant out.

We have, however, definite proof that under certain circumstances deer may be a very important factor, both for sal seedling and coppice regeneration, and we have to take serious note of it in our regeneration areas.

6. Another factor in sal regeneration that has received consideration is mixed or pure overwood. F. C. Osmaston (9) advocates a mixed crop of sal and miscellaneous species as ideal for obtaining sal seedling regeneration. Davis (15) and Chaturvedi (16) are even more emphatic on the subject. A mixed crop has in fact been advocated as the ideal to aim for in most recent United Provinces working plans.

And then Shebbeare (13) writes, not as a matter of opinion but *recording definite facts*, (*a*) that the sal forests of Kamrup are practically pure, and those of Buxa contain many other species both in intimate mixture with sal and in intermingled tracts which contain no sal, (*b*) that the sal regeneration in Kamrup is entirely natural and in Buxa entirely artificial (since natural regeneration is impossible), (*c*) that the Kamrup method is impossible in Buxa and the Buxa method quite unsuited to Kamrup.

Such a flat contradiction from such a source must be rather upsetting to foresters who think that our difficulties will be over when we have mixed instead of pure sal crops to deal with.

7. This brief review of notes and articles published during the last decade refers to four important factors, *i.e.*, manipulation of canopy, fire, deer, and mixed or pure crops. The harassed student of sal regeneration

is, I think, entitled to grouse at a species which gives rise to such conflicting results and opinions on all these factors.

One thing we have definitely learnt is to think in four dimensions and not in one or two dimensions, as neglect or inattention to any one factor may lead to failure.

8. And now having given some indication of the discrepancies and contradictions with which we have been faced, I will first set out the broad idea which I believe explains some of these difficulties, and then support the theory with some concrete examples.

I think I may take it as an axiom that *protection in general, and fire protection in particular, helps the progression of an area from one plant association to another, always in the direction of the climatic climax, while destruction, and especially fire, reverses this progression.* As Troup (1) has put it: "In some types of forest the equilibrium of the existing vegetation is maintained by the action of annual forest fires, and some remarkable cases may be observed of a complete alteration of the type of forest brought about through the introduction of fire protection in areas previously subjected to regular burning. Succession in such cases is progressive, the succeeding type of forest being more hygrophilous than the pre-existing type."

I think I may also take it as an axiom that *any change towards drier or hotter climatic conditions tends to revert the climatic climax to a more xerophitic plant association.* This is self-evident.

9. One has been accustomed to regard a sal forest as something which always has been and always will be a sal forest, but under certain conditions this is, I believe, our fundamental mistake. *With fire protection we must usually* regard a good quality sal crop as merely a stage in the progression of the area from one plant association to another.*

10. The idea that a sal forest may be transient, and in the time-space continuum may fade away as a morning mist, will probably come as a shock to many foresters, so the evidence must be carefully examined. The progression of forest crops in the submontane tracts is no new idea. In my note (3) on the forests of the Kumaon-Bhabar, published in 1921,

*NOTE.—The main exception would be where sal was itself the climatic climax, which is probably the case under rather xerophitic conditions, and here we often find the first-half of the progression going on. Exceptionally we may find sal as the climatic climax itself reverting to a lower stage, as discussed later in this note.

I wrote :—" The progression of crops in the Bhabar may, in fact, be tabulated as follows :—

1st stage.—The *shisham* (*Dalberagia sissoo*) crop.—Reproduction on absolutely bare porus river gravels, no surface soil, and water supply dependent on the proximity of river or stream.

2nd stage.—After a few decades, a surface soil of coarse sand covers the underlying river gravels, and the biological conditions are favourable to the introduction of *kanju* (*Holoptelea integrifolia*).

3rd stage.—After the lapse of some indefinite period, the loose sand has, in its turn, been covered by two or three feet of loam, which retains a certain amount of the rainfall water, and the time is ripe for *dhauri* (*Anogeissus latifolia*) and its associated species.

4th stage.—With the passing of some centuries the loam has increased to an appreciable depth (ten to fifteen feet), the water-content and fertility have increased very considerably and the biological time for sal (*Shorea robusta*) has arrived.

All these stages can be studied in various parts of the Bhabar. Beyond the sal stage we cannot follow the progression further ; whether it lasts indefinitely or whether sal in turn gives place to some other species, it is in our present state of ignorance profitless to discuss."

11. During the decade since those words were written, we have increased our knowledge, and we now have strong evidence that sal may in turn give place to some other species. Troup (1) has clearly described the successive progression from savannah *through* sal to evergreen as a result of fire protection in the Bengal Duars. "The forests of the Duars, more particularly those of the moist type, furnish a striking example of the effects of continued fire protection in altering the character of the forest. It is an indisputable fact that the existing sal forests had their origin in burnt savannah lands. When a burnt savannah is fire-protected, where sal existed on the burnt savannah a more or less pure sal forest results. This, however, is only a stage in the progressive succession towards forest of a moister and more evergreen type. . . Evergreen shade-bearing trees commence to form a lower storey, the larger species penetrating to the upper storey. The whole mass is cemented

together by a luxurious growth of climbers. . . . Such is the state to which the sal forests of the Duars, which originated in burnt savannah lands, in some cases possibly with an intervening stage of burnt deciduous forest, have been brought after a period of some 30 or 40 years of fire protection. A condition has been reached in which the natural reproduction of sal is out of the question, and the future of the species can be secured only by artificial reproduction."

It is I think probable that the phenomenon so well described by Troup for the Bengal-Duars, is of far wider application, but that as the velocity of the progression varies with the rainfall and moisture we have been slower to recognise it in the United Provinces with our drier climate.

12. Mobbs (4) describing the submontane forests of Saharanpur explains how both progression and regression has been going on :—

"In the 'plains' forest at the foot of the hills there are all types of vegetation representing all stages of succession from the colonisation of recent riverain soil to the established climax forests, with sub-climaxes and regressions due to limiting factors or the effect of past treatment of the forests. The climax formations may be taken as a good miscellaneous forest where the soil conditions are dry or very moist, and a sal or a sal and miscellaneous forest where the soil is of better quality and is neither too dry nor too moist. There are two distinct lines of succession leading to the climax types, although they frequently overlap and merge into each other. In the one, the riverain area is colonised more or less direct by tree growth. The riverain forest thus produced gradually changes to the climax by the introduction of other species with increasing density, the whole succession being represented by tree growth. The other line of succession commences from a purely grass type. This changes to an open grassy savannah, then to open miscellaneous forest, and, finally, to the climax formation. The open savannah may occasionally be a true climax type, but so far as the 'plains' forests of this division are concerned, even when it appears to be a stable formation, it must be regarded as a sub-climax with grazing and fire as limiting factors. In the areas open to grazing and annual burning this is obviously the case. But there are also extensive savannah areas which are closed to grazing and fire. In these a careful search will reveal a large number of young trees coming up, typical of the open miscellaneous forests, and there

is no doubt that with complete protection these savannah areas would change to forest."

"The sal forest must be regarded as quite a separate climax formation from the miscellaneous forests, and is characteristic of the better soils. It is to be found where there is good loam overlying the boulders of the Siwalik *bhabar* at the foot of the hills, where tongues of clay extend from the outer hills into the plains, and lower down, where the pre-Siwalik *bhabar* is covered with a fairly good soil. That sal was formerly more extensively distributed than it is now, and extended well into the plains, is shown by the good patches of sal forest on low conglomerate hills in Sakrauda block, and by the isolated old trees found elsewhere in the same block, notably to the east of Khanpur bungalow."

"The presence of several open savannah-like areas in which sal is the chief species, indicates that the sal climax may develop direct from the savannah, and there is no need to regard the miscellaneous forest as a necessary forerunner of the sal forest. The two types of forest represent two separate climax formations of parallel succession, and where many miscellaneous species occur with the sal, the area may be a transition between the two types, or the miscellaneous trees may have come in due to the removal of the sal by man. . . Regression has occurred in some of the miscellaneous and mixed sal and miscellaneous forests. . . The sal forests have not been subject to such drastic fellings, but semi-savannah conditions have been set up in which *munj* (*Saccharum arundinaceum*) and *Saccharum narenga* are the commonest species."

13. Bourne (5) in a recent publication wrote :—"There are enormous areas within the Empire in which the forest vegetation has been so modified by man, for instance through the agency of fire, that the true relation of vegetation to climate and soil may be largely obscured. There is little doubt that many types of forest in both temperate and tropical climates have been mistakenly considered to represent the climatic optimum, though admittedly modified by biotic or other factors. Evidence is not lacking that shifting cultivation, unrestricted grazing, and fire can completely eradicate the natural species of a climatic region. Even if the resultant vegetation is forest, it may bear no resemblance to the true climatic type."

This is profoundly true, and the submontane forests of the United Provinces, Nepal, Bengal, and Assam, appear to afford a striking example. Milroy (14) in his illuminating article in the "Indian Forester" has also noted: "We know from old records and local tradition that most of the sal reserves in the plains of Assam and in the Bengal-Duars originated from fire swept grassy tracts containing clumps of sal such as may be seen to this day in the *zamindari* forests." Similarly the origin of the finest United Provinces sal forests of Haldwani and North Kheri may be seen to this day in the adjoining forests of Nepal.

14. The miscellaneous forests of Gonda supply another interesting illustration. The current working plan (4) points out that the existing forests, chiefly of *dhau* (*Anogeissus latifolia*), *haldu* (*Adina cordifolia*) and in the clay soils, *asna* (*Terminalia tomentosa*) commenced with forest protection in 1866 on soils absolutely ruined by uncontrolled grazing and burning. These crops are now approaching maturity, but there appears not the slightest hope of their natural regeneration. Instead we find an invasion of sal round every scattered seed-bearer or odd group of sal together with other hygrophilous species such as *jaman* (*Eugenia jambolana*) Croton, etc., an example of parallel succession. Quite recently the Divisional Forest Officer has experimentally started the conversion of some of these miscellaneous areas into sal artificially, with every prospect of success. In the same division and within a mile or two of the sal invasion into dry miscellaneous crops, we have pure sal forest, treated during the last ten years on a Periodic Block system, with heavy seeding fellings in P. B. I. in the usual way, and we have obtained the usual regeneration of hygrophilous miscellaneous (and worthless) species, chiefly *rohini* (*Mallotus philippinensis*).

15. The origin of the fine sal forests of the Western Circle is clearly shown in the famous despatch of November 1862 from the Government of India to the Secretary of State, from which the following extract is taken :—

"In the North-Western Provinces the difficulty of obtaining timber has been painfully felt for the last fifteen years or more, but the administration of the forests there up to the time of the Mutiny was a melancholy failure. A superintendent was appointed in 1854 to the charge of the forests in the Dehra Dun and the west of Rohilkhand, the result of whose bad management was the completion of the ruin of almost all

the forests that still contained good sized trees. At present the most important part of the North-Western Provinces forests is under the direct management of Lieutenant-Colonel Ramsay, the Commissioner of Kumaun, who has at last introduced order into the administration. But he works on the wreck of the forests, and it will take many years to restore them to a proper condition." In 1863, Colonel Pearson was appointed the first special Conservator, who in 1871 wrote "that thanks to the care of Colonel Ramsay, *the forests are now everywhere recruiting themselves*."

We have, therefore, convincing evidence that our existing well-stocked and well-grown sal seedling crops started either in "grassy fire-swept tracts" or in open miscellaneous and grassy forest, mixed with seed bearers and clumps of sal forest, or in ruined sal forest. *I know of no evidence in the United Provinces that any existing dense sal area ever started under a similar dense sal crop.*

16. To consider now the other end of the progression. Troup, Shebbeare, and Milroy have explained how successful fire protection first favoured the establishment of fine sal crops in grass lands and then caused evergreen invasion which made sal regeneration impossible, with the result that in Buxa the regeneration problem is solved by *taungya*, while in Kamrup Milroy by the aid of fire gets regeneration by deliberately going back to the stage of "grassy fire-sweept tract with clumps of sal."

17. In the United Provinces we have also some evidence. I have already explained above how nature has regenerated many of our *best quality* P.B.I. areas during the last 10 or 15 years with hygrophilous miscellaneous species, chiefly *rohini*, except where the ground was already occupied by suppressed sal woody advance growth. For example, the 1921 clearfelled and shelterwood experiments of Haldwani were almost pure *rohini* crops 25′ high when the experiments were abandoned in 1930. In some nearby compartment we have -or had—an older stage of the same hygrophilous and valueless miscellaneous forest predominantly *rohini*, with an occasional group or large scattered old sal, which is found impossible to burn at any time of the year, and impossible, I believe, to regenerate naturally with sal. The area of this type has been reduced during the past five years by converting it artificially into most promising teak plantations. There are still a good few acres left, however, to serve as an illustration of what the next economically valueless stage will be in

the progression towards the climatic climax, and I believe these few acres will soon swell to thousands—from some of our best sal forests allotted to periodic block I—unless we do something to check it. And it seems to me there are only two possible alternatives for us to adopt, one is to follow Shebbeare and Buxa, *i.e.*, artificial regeneration, and the other to follow Milroy and Kamrup, *i.e.*, regeneration by fire.

18. Bourne (5) has noted :—"In general it may be said that the costs of establishment are in inverse proportion to the suitability of a species to the locality ; the more suited the species, the lower is the cost." Applying this test to our sal forests we find that in the 1860—1880 period sal was pre-eminently suited to the existing conditions, since the cost of establishment was merely fire protection, a few annas per acre. But in these same areas in 1920—30, sal is apparently totally unsuited to the new condition, since we cannot get it naturally at any price, and artificially (except by *taungya*) it costs anything up to Rs. 100 per acre. On the other hand *rohini* and teak must be wonderfully well-suited to the locality and the new conditions, since the former costs nothing at all to establish, and the latter not very much.

19. But this is rather a digression from the main theme of this article, wherein I set out to try and reconcile contradictory opinions. Hitherto I have been considering mainly the fertile good quality type of sal forest of the *bhabar* terraces and *damars*, where sal is at its optimum development. But when we consider the poor quality xerophitic type of sal with such associates as *Dispyros tomentosa, Nyctanthes arbor-tristis, Ougeinia dalbergiodes*, etc., on well-drained dry and often hilly shallow soils, we find that fire protection, by conserving the available moisture, helps the sal considerably, and is in fact essential. (But even the beneficent action of fire protection may be swamped by change of climatic conditions.) And again, where we find sal fighting with the big savannah grasses of the badly drained *tarai* such as *ulla* (*Anthisteria gigantea*), successful fire protection is equally essential, and a whole working circle in North Kheri division indicates how the sal will ultimately defeat the grass, (but probably will itself be defeated in the next rotation by *rohini*, if fire protection is indefinitely continued). Also there are areas in South Kheri which are patently reverting to savannah, due to rather frequent terrific fires which we cannot control.

20. Drought and a drop in the water level is another phenomenon which has been known to reverse the normal progression of crops, and to convert sal forests into a drier type of miscellaneous forest, *e.g.*, in parts of South Kheri, Bahraich and Ramnagar divisions. And here I may refer to the dry type of sal forest found on and below the outermost slopes of the Siwaliks in the west of the United Provinces, *e.g.*, in Saharanpur and Ramnagar divisions. For many years it has been recognised that sal regeneration has almost entirely stopped. Thus the Saharanpur working plan of 1923 noted :—" It has been established that there has been an appreciable deterioration of the sal areas during the last 35 years. The satisfactory natural and coppice reproduction referred to in old reports is entirely unobtainable to-day." The current plan for these forests also notes that there has been a decrease in the density of the canopy, a great increase in the grass and probably also in the dryness of the forest. Extracts from the working plan have been given above. Similar conditions prevail in most of the drier parts of the Jaspur forests of Ramnagar division, which for decades have been treated under cautious improvement fellings and thinnings, where, despite protection from fire and grazing, there is no vestige of established sal regeneration and practically no hope of it, while trees of the overwood keep dying off (probably from drought). In fact the current working plan describes the Jaspur sal as a dying species owing to some change in the condition of the locality. The masses of sal seedlings which are produced in seed years (1913, 1918, 1923, 1926) mostly disappear in the first hot weather, and the few survivors never become established. It is quite evident that the ecological conditions must have altered considerably since the existing sal crop started, and it is equally evident that *despite* protection, these forests are reverting to a more xerophitic stage. In fact they suggest that *the climatic climax is itself reverting to a stage below the sal stage*, a reverse example to the progression that Troup has described in Bengal.

21. A reversion of the climatic climax can only mean a gradual change in the climate to drier or hotter conditions, and although Troup (1) states that there is no evidence of a change in climate over India as a whole, yet Professor Mukerji of Lucknow has cited historical and other evidence which suggests that the arid conditions of Bikaner and East Punjab are slowly creeping eastwards and are definitely beginning to affect the *Western districts* (Agra, Muttra, Delhi, etc.). This is not a new idea,

Trevor has pointed it out as almost inevitable. "Following excessive disforestation the local climate becomes worse. The destruction of stands has produced disastrous climatic changes in Greece, in Russia, in Asia Minor and in certain parts of India. All history agrees on this point." If this is so, it would go a long way to explain our present difficulties in regenerating sal on these dry soils and xerophitic conditions, since sal seedling regeneration would be a far more delicate indicator of any such change than the existing sal crop. For without any measurable decrease in annual rainfall, sal seedlings on the borderline might well succumb to fiercer hot weather conditions, which would not affect the main crop. It is in fact difficult to suggest any more plausible explanation of the admitted facts that natural sal regeneration is now unobtainable and that these sal forests are gradually disappearing and becoming a more xerophitic association. The hygrophilous tendency of fire protection is here swamped by the stronger xerophitic tendency resulting from climatic change, an influence that does not affect the eastern districts.* And thus we have the apparent anomaly of sal growing (at first sight) under conditions which elsewhere would be considered ideal for its regeneration, *i.e.*, as in Kamrup with an undergrowth of thatch or as in Gonda scattered about in mixed deciduous forest, and yet with no trace or even hope of regeneration. It is conditions and results such as this that seem flatly to contradict apparently similar conditions and results elsewhere, which make the problem of sal regeneration so difficult.

22. The illustrations and examples given above will, I hope, suffice to justify and define the broad idea which I have given, *that with fire protection a good quality sal crop must usually be regarded as a stage in the progression of an area from one plant association to another, and that climatic changes may tend to revert sal to a more xerophitic association.* Let us see how this helps to explain the conflicting views and results recorded regarding sal regeneration.

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*NOTE.—There is an element of doubt even about this statement. Thus Mobbs (4) in the new South Kheri working plan writes as follows:—"In the local district Gazetteer it is stated that the heat of Kheri is less than that of the adjoining parts of Oudh and that records taken in former years show that the thermometer seldom registers over 100°. On the other hand, shade temperatures recorded by the writer under ordinary conditions on tour during 1929 showed that from April 1st onwards the maximum shade temperature was seldom below 100°, being from 100° to 110° in April and from 105° to 114° during May and June." The discrepancy is rather remarkable. Either the Gazetteer is very wrong, or the hot weather must be a good deal fiercer now than it was previously.

(*a*) Manipulation of the canopy $\frac{\text{will}}{\text{will not}}$ assure successful regeneration.

Although in our dense sal forests, manipulation (*i.e.*, opening) of the canopy is *essential*, it is not the only factor to be considered, and by itself will fail whenever the progression is to the next higher stage. Wherever there is regression, it is useless.

(*b*) That controlled burning is $\frac{\text{essential}}{\text{fatal}}$ for sal regeneration.

It is essential where the progression is from sal to the higher plant association (*rohini* or evergreen) unless the progression has gone too far. It is fatal where there is regression to a lower stage, or where the progression is from the lower plant association (heavy grass or dry miscellaneous forest) to sal ; it is essential for a time under hygrophilous conditions to reverse the normal progression and turn sal to thatch, but must then be stopped to enable the sal to grow up in the thatch, it is useless where this regression is going on of itself.

(*c*) That deer are a $\frac{\text{vital}}{\text{negligible}}$ factor in stopping sal regeneration. We have not as yet got to the bottom of the vagaries of deer damage but it is now definitely proved that deer (*i.e.*, sambhar) are sometimes a vital factor and sometimes a negligible factor. We cannot, however, at present correlate this with the stage of progression of the crop.

(*d*) That sal forest must be $\frac{\text{pure}}{\text{mixed}}$ to regenerate successfully.

If the sal is mixed with the lower type of dry miscellaneous in a state of progression, it will regenerate well, if mixed with the higher type of moist evergreen miscellaneous, it will not regenerate well, possibly not at all. The two types of miscellaneous are totally different. But if the sal is in a state of regression to dry miscellaneous, despite fire protection, it will not regenerate well.

23. I venture to think that a suggestion which seems to reconcile satisfactorily such apparently irreconcilable opinions deserves more than passing consideration. If accepted as approximately correct it suggests that in our present management of the United Provinces sal forests :—

(*a*) We are correct in fire-protecting all dry sal areas, and where sal is fighting with *ulla* grass.

(*b*) If the evergreen invasion cannot now be eradicated by burning, we have no alternative but artificial regeneration, and therefore we are correct in continuing fire-protection to improve the soil conditions until the time comes to fell and *taungya* (or otherwise regenerate artificially).

(*c*) We are wrong to expect to get natural sal when and where we wish in fire protected sal crops where progression to the higher evergreen association is actively and visibly taking place. We have to choose between the two alternatives, Kamrup or Buxa.

(*d*) We cannot expect natural sal seedling regeneration when we are faced with a regression of the climatic climax to a more xerophitic type. In such cases we are as helpless as Babylon or Nineveh to stop the course of Nature.

24. It also suggests for future management that we have one of the most complicated and difficult forest problems the world has ever seen. To keep the delicate balance that prevents the progression going too far forward or regression too far back is the least difficult part of the problem. In every compartment or sub-compartment we have to recognise at what stage the progression is and treat it accordingly. Where whole blocks or working circles are in one stage, the recognition and treatment are not too difficult, but where a sal region breaks up into a constantly recurring succession of different sites, each site characterised by a different stage of the progression or regression (and therefore requiring different management) but frequently ill-defined and merging into one another, the practical difficulties of the problem become apparent. In such areas we are faced with an even more detailed examination and description of compartments and more varied intensity of management than we have ever contemplated before.

25. To summarise the main points of this article :—

The United Provinces sal forests are often in unstable equilibrium with two principal factors influencing them, *i.e.*, fire protection tending towards hygrophilous progression, and a slight change, probably climatic, which by influencing the ecology tends towards xerophitic regression. The former is dominant in the better quality forests on moist fertile loams and in the east, the latter is dominant on dry poor soils in the west. These two opposing factors give rise to some at least of the numerous conflicting results recorded in the study of the problem of the sal regeneration.

Deer and canopy manipulation are also important influences that cannot be neglected.

The great lesson to be learnt is that to generalise is very dangerous and the great question to be considered is whether a species or forest in unstable equilibrium (and therefore usually tending to change into somehting else) can possibly be managed under the Uniform or Shelterwood Compartment System, which is dependant on getting natural regeneration when and where we wish. It *may* be possible, if we can simultaneously control all the different factors, but in practice it is certainly a far more difficult problem than was at first realised.

Literature and Published Articles Referred to in this Article.

A.—Publications.

(1) Troup. Silviculture of Indian Trees, 1921.

(2) Hole. Regeneration of sal forests, Forest Record, Vol. VIII, Part 2, 1921.

(3) Smythies. Miscellaneous forests of the Kumaon Bhabar. Forest Bulletin No. 45, 1921.

(4) Current working plans of Ramnagar, Gonda, Saharanpur, Haldwani, etc.

(5) Bourne. Regional Survey, 1931.

B.—Articles in the "Indian Forester."

(6) Hole. Soil Aeration. May, 1918.

(7) Hole. Regeneration of sal forests. March, 1919.

(8) Ford Robertson. Sal Regeneration. September-October, 1927.

(9) F. C. Osmaston. Sal and its regeneration. November-December, 1928.

(10) Smythies. Sal and its regeneration (deer). November, 1929.

(11) Champion. Sal and its regeneration (deer) April, 1930.

(12) Smythies. Sal forests of Haldwani, North Kheri and Nepal. June, 1930.

(13) Shebbeare. Fire and Sal regeneration. July, 1930.

(14) Milroy. Sal forests and fire. October, 1930.

(15) Davis. Sal regeneration fellings. April, 1931.

(16) Chaturvedi. Regeneration of sal in the United Provinces, April, 1931.

1. *Eucalyptus rostrata* lines in Compartment 58—21 months old. (Photo by the writer.)

2. Mixed crop in Compartment 69. Eucalyptus has been raised from "pot" plants—9 months old.

(Photo by Dr. Gorrie.)

EUCALYPTUS CULTIVATION IN CHHANGA MANGA PLANTATION.

BY FAZL MOHAMED KHAN, I.F.S.

(In the following note, wherever used :—
Cuttings mean root and shoot cuttings.
Pot-plants mean seedlings raised in bottomless pots).

1.—*Introduction.*

Experiments to introduce *Eucalyptus* spp : in Chhanga Manga Plantation were started long ago, and are described in detail in Khan Sahib Allah Bakhsh's article on Nursery-treatment and planting of Eucalyptus species published in the "Indian Forester," Vol. LIV, November 1928; but it is only lately that the cultivation of *E. rostrata* on a fairly large scale has been successfully attempted.

2.—*Brief History.*

Looking into the old records one finds reference to the creation in 1903 of a small nursery of *E. globulus* in the compound of the Forest Rest House at Chhanga Manga where a few trees of this species still survive. In 1911 a proposal to replace the fungus infected *shisham* standards by a suitable Eucalypt was turned down by the Conservator. Still in May 1913 several Eucalyptus species including *E. rostrata*, *E. tereticornis* and *E. siderophloia* were planted in compartment 60 while experiments were carried out in the Rest House compound with 21 other Eucalyptus species. The result appears to have been indifferent, but the few specimens of *E. tereticornis*, *E. citriodora*, *E. melanophloia* and *E. rostrata* which are found in these places are the obvious survivals of these experiments. They are fine specimens too, and incidently indicate the enormous possibilities of the tree in this plantation.

A further step in the Eucalyptus cultivation was taken in April 1925 when 500 seedlings of *E. rudis*, 4 to 6 inches in height, were obtained from Lawrence Gardens at Lahore and transplanted in a raised bed in the Rest House compound. By the following March they had grown 10 to 15 feet high. These were then converted into cuttings, 40 of which were planted in the Range Office compound and 200 were transferred to a sample plot in compartment 25 in March and April 1926. The result at both the places was very encouraging. In 1925-26 a more ambitious programme was

taken in hand and a local nursery was established in compartment 8 near the Sale Depôt. Seed of 4 different species *E. rudis*, *E. tereticornis*, *E. rostrata* and *E. siderophloia* was sown in March and by the end of the following October, 12,223 seedlings had been raised "giving 41 per cent. success." According to the species the success was in the order given above. By the 15th March 1927 these seedlings had grown 6 feet high on the average. In April 1927, 8,031 cuttings obtained from them were planted out along with *shisham* cuttings in compartment 37, one of the former alternating with 4 of the latter. Out of these 1,052 plants survive to-day, the rest having been destroyed by white ants or on account of inadequate irrigation or suppression by weeds in the first year. Fresh sowing of the seed of *E. tereticornis, E. rudis, E. viminalis* and *E. macrocarpa* were made in April 1927, but only the first three species gave good results. 27,461 cuttings obtained from this lot were planted out in April 1928 in compartments Nos. 40, 41 and 42 along with *shisham* cuttings again in the order 1 to 4. Survivals from these are 800 plants in compartment 40, 3,475 plants in compartment 41 and 115 plants in compartment 42, although cotton *taungya* was allowed between the lines to keep down the weeds. In some cases failures were replaced by "pot" plants from the nursery.

In 1929 a permanent nursery was established near the Range quarters; and in April of the same year cuttings of *E. rostrata*, *E. paniculata* and *E. crebra* raised in the old nursery were planted out along with *shisham* (*Dalbergia sissoo*) cuttings in compartment 56, this time the order being 1 to 2. The first named gave the best result. Cotton *taungya* was again permitted with a view to keeping down the weeds. Failures among the last two species were replaced by "pot" plants of *E. rostrata* with fair success. In April 1930 cuttings of *E. rostrata* were planted in compartment 58 at $10' \times 5'$ intervals as a pure crop and at the same time "pot" plants were planted in about 6 acres to see if direct planting would reduce the percentage of casualties which resulted from planting out cuttings. Cotton *taungya* was also permitted to keep down weeds. In the course of the year, however, coppice and root suckers of *shisham* and coppice and seedlings of mulberry appeared all over the area. These were not interfered with except where they suppressed the Eucalyptus transplants; and the result is an excellent example of the mixed crop which will result from the introduction of Eucalypts in the plantation.

3. Loading a tramway truck-stretcher in the foreground.

4. Nursery avenue of *Eucalyptus rostrata* —21 months old.

(Photos by the writer.)

The operations so far conducted established the following facts :—

(*i*) *E. rostrata* is pre-eminently the most successful Eucalyptus grown in Chhanga Manga. It is easy to raise in the nursery and easy to transplant in the forest both as cuttings and as "pot" plants.

(*ii*) Although cuttings readily sprout, casualties among the resulting shoots from one cause or other, amount to nearly 60 per cent. which is much too much.

(*iii*) "Pot" plants when 4 inches high can be transferred with advantage from the nursery to the forest and failures among them hardly amount to 10 per cent.

Accordingly in 1931 the Eucalyptus cultivation advanced another stage and while cuttings from last year's seedlings were used to plant up a part of compartment 69, a part of it was planted up with "pot" plants of the year ; and in future most of the planting will be done with the latter.

The areas where stocking with Eucalypts has so far been attempted are :—

Year.*	C. No.	Acres.		Remarks.
1926 (April) ..	25	1		Fully stocked. Was thinned in 1930 and a sample plot laid out by the Forest Research Institute.
1927 ,, ..	37	28		Only 1,052 plants survive. Two of the biggest measured on 29th October 1931, were 2·3½ inches each at breast height.
1928 ,, ..	40 41 42	58·6 48·6 11	800 3,475 115	Plants survive according to the enumeration done in November 1931.
1929 ,, ..	56		29	About 60 per cent. of the cuttings failed and had to be replaced by "pot" plants.
1930 ,, ..	58		54	
1931 ,, ..	69		64	26 per cent. cuttings and 5 per cent. "pot" plants failed but the failures were replaced in the same season.

* In every case the planting was done in April, although failures continued to be replaced till the end of June.

3. —*Nursery.*

Nursery technique to raise seedlings of *E. rostrata* for planting out has been developed from a series of experiments dating from 1925; but essential part is constant irrigation of the seed bed by percolation, while the best results have been obtained from sowings in bottomless pots of burnt clay.

Seed.—It is best to obtain seed direct from Australia. Messrs. Andrew Murphy, Woy Woy, W. S. W. Australia, are one of the seed exporters who have been supplying good seed for Chhanga Manga at £ 1 per pound exclusive of the cost of transport which comes to about a shilling per pound. The seed is extremely small but it preserves its vitality for at least two years if kept with ordinary care. One ounce is sufficient to raise 3,000 plants.

Bottomless pots.—The most suitable size of the pot for raising the seedlings in nursery is 6 inches in height, 6 inches across at the top and 4 inches across at the base. It has no bottom—hence called bottomless, and its wall is a quarter of an inch thick. Bigger pots or thicker walls will interfere with the percolation of moisture and smaller sizes will not accommodate seedlings or will break in handling. *They should be made of sandy clay* to ensure porosity for percolation of moisture from outside. The local pot makers of Chhanga Manga charge Rs. 22/- per thousand delivered on spot.

Sowing.—Sowing is done in the second week of February. Pots are filled with well sifted humus soil to a depth of 5 inches, on the top of which half a dozen seeds are put. They are then placed side by side in slightly sunk nursery beds into which water is let in, care being taken that it rises only to the level of the soil in the pot, but does not flow over. The water rises by percolation into the pot soil and supplies the necessary moisture for the seed to germinate. It is very necessary that the soil in the pots is *not packed hard* and is kept moist by daily irrigation.

Nursery beds should be $11' \times 3\frac{1}{2}'$ so as to accommodate 100 pots each and should be separated from one another by 2 feet wide ridges which will serve as paths to move about for inspection and weeding. Cost of nursery operations, exclusive of the initial cost of laying out nursery beds and cost of pots, is about Rs. 9/- per 1,000 plants in Chhanga Manga.

Seedlings.—Germination starts in ten days' time, but with inadequate irrigation the seed takes much longer to sprout. Percentage of success in the case of imported seed is about 80. Failures in pots are replaced by transplanting 1″—2″ high seedlings from pots which contain more than one. In a month's time after germination the seedlings attain a height of about 4 inches, and their roots grow about 5 inches long, or, are just about to pass from the pot soil into the ground below. At this stage pots are transferred either to other parts of the nursery for wider spacing, if extraction of cuttings is the object, or direct to the planting areas for "pot" planting. In the former case the pots should be spaced 1½ feet apart to allow the seedlings ample room to put on 1½ to 3 inches girth at the collar within the year as this is the most suitable size for cuttings. Pots are removed for future use from the seedlings, whether placed in the nursery or planted out, when the latter are about 10 months old and are well established in the ground. Constant irrigation from the date of sowing till the breaking of the monsoon and weeding of the pots till the plants are at least three feet high are essential for success in nursery work.

4.—*Planting.*

Planting out of *E. rostrata* either (*a*) as cuttings or (*b*) as pot plants starts as soon as irrigation commences which in Chhanga Manga is 1st April at the earliest. The cuttings, however, should be planted out in the beginning of March wherever irrigation can be had earlier.

The area where planting is done is in every case in Chhanga Manga the regeneration coupe. It is felled over in winter and all the wood is removed to the stacking lines, and the brushwood is burnt by the end of February. In March the trenches are dug (or old trenches renewed as the operation is locally known) at 10 feet intervals. They are 1 foot across section but vary from 6 to 12 inches in depth according to ground levels. By the end of March everything is in condition to receive the irrigation. Irrigation commences early in April, and the trenches are flooded. When the water has all soaked into the soil, slots are made in the side of the trench, which is shaded from the southern or western sun, at 8 feet intervals. For "pot" plants the slots are made flush with the trench bed, but for cuttings they are kept three inches above the bed of the trench as submergence of the cutting in the irrigation immediately following the planting is believed to retard sprouting and is therefore not desirable.

(*a*) *Cutting.*—As every forester probably knows by now a root and shoot cutting is 1 foot in length and consists of 9 inches of the root and 3 inches of the shoot part of a seedling. The most suitable thickness of *E. rostrata* cuttings for planting out lies between the average small finger and thumb of a man's hand. Thicker or thinner cuttings are not used as they generally fail. Seedlings are watered in the morning and dug out and converted into cuttings in the evening. They are carried to the planting area at night, or else well packed in moist grass, and are buried under moist earth wherefrom they are taken out as the planting proceeds. As the days are not very hot early in April, and as planting is done in wet soil to be followed immediately after by another irrigation, the hour of planting is not very material, but evening hours should be preferred. Actual planting is easy as the trench sides are wet after the initial irrigation, and all that is needed is to push the cutting *root downwards* up to the collar into the bottom of the slot some 3 inches away from the edge. Where the slots are not wet enough for the purpose, "peg" planting is resorted to, but this is costly and with a little *bandobast* should not be necessary. About a dozen men are employed on this work, and as soon as one section is completed water is let into the trenches, care being taken that it does not flow over the edge into the slot and submerge the cuttings. Sprouting starts within a week of planting. Growth is very rapid and in one year the shoots attain a height of 10 feet on the average.

(*b*) "*Pot*" *planting.*—"Pot" plants are transferred to the forest when they are about a month old, that is, before their roots strike the ground below the pots, so that they remain undisturbed in transit. Tramway trucks are used to transport them from the nursery. On arrival in the planting ground they are placed in a shallow bed of water under a temporary grass covered shed to protect the tiny seedlings from desiccation. For carrying them about in the nursery as well as in the planting ground stretchers are employed. These accommodate 24 to 28 pots and are handled by two men. When planting the "pot" plants are put in the slots and fixed in position by filling the space around them with earth. Water is let into the trenches immediately after and care is taken that it does not overflow into the pot and submerge the seedling. The growth is fairly rapid and in a year the plant attains a height of 6 feet on the average. To replace failures bigger "pot" plants are utilized, but transplanting them is difficult. Still satisfactory results have been obtained

by pruning the roots which have passed out of the pots and at the same time removing the leaves in order to reduce transpiration in transit.

The young plants of *E. rostrata* are very sensitive to the effects of inadequate irrigation and suppression. It is, therefore, essential that they should get at least one irrigation a week and should be kept free of top shade of every kind in the first year. In after years repeated irrigation will undoubtedly help the plants to grow but even with one irrigation, which alone is available, the results are very encouraging.

Each of the two methods of planting described above has its merits and demerits which are compared in the following statement. On the whole " pot " planting has so far been far more successful and economical than planting out of cuttings :—

Cuttings.	" Pot " plants.
1. Plants stay for one year in the nursery where they have to be carefully tended. Cost of shifting, weeding and irrigation exclusive of water comes to Rs. 7-11-0 per thousand.	1. Plants are taken direct to the planting ground when about a month old. Transplanting and tending in the nursery are eliminated.
2. Plants have to be dug out and converted into cuttings. This involves appreciable waste of seedlings. Also cost comes to Rs. 1-14-0 per thousand.	2. The operation is eliminated.
3. Transport to the planting area costs Re. 0-5-0 per thousand.	3. Transport to the planting area costs Rs. 2-6-0 per thousand.
4. Pushing into wet slots costs Rs. 1-2 per thousand. " Peg " planting costs Rs. 5-3-0 per thousand.	4. " Pot " planting costs Rs. 7-3-0 per thousand.
5. Casualties from various causes have ranged between 60 and 26 per cent. and have had to be replaced by " pot " plants.	5. Casualties from various causes have ranged between 10 and 5 per cent.
6. Plants raised from cuttings grow to a height of about 10 feet in the first year.	6. Plants attain an average height of 6 feet in the first year.
7. Outside the nursery there is no breaking of pots, as the pots don't need to be taken out.	7. Breakage of pots in the forest will be appreciable although it has been determined.

5.—*Injuries and their remedies.*

(*a*) *White ants* destroy cuttings in large numbers. The attack commences as soon as the ground dries after the first irrigation. Healthy shoots are also attacked in the first year but this is not common. The affected plants turn sickly and can be readily spotted. They die if the attack is not checked in time, but their recovery is marvellous if the white ants somehow retire. Irrigation does check their activity but only temporarily. A very effective and cheap remedy discovered in the course of experiments is *hukka* water which becomes a light solution of nicotine when the *hukka* has been smoked for some time. The irrigation labour carry about this solution in tins and pour a cupful of it at the base of the affected plant. In almost every case where it has so far been tried the white ants retreated and the plant recovered. A dry tobacco leaf soaked over night in a gallon of water should produce an equally effective solution. In the case of "pot" plants the pot effectively keeps off the white ant from the plants.

(*b*) *Fungi.*—The fructifications of *Genoderma lucidum*, which is the new name of the dreaded *Fomes pucidus* of the *shisham* irrigated plantations, were observed on a few nursery seedlings in September 1930. Some of the casualties among the Eucalyptus plants in the plantation are believed to have been due to this disease.

(*c*) *Weeds.*—Eucalyptus seem to abhor top shade and cannot stand suppression. In the first few months of the plant's life, therefore, it must be kept clear of weed which is a costly operation in Chhanga Manga, the average cost coming to Rs. 10 per acre for the season. Cotton *taungya* between the lines helps in keeping down the weeds.

(*d*) *Drought.*—In the first year at least one irrigation a week is essential in summer months otherwise the young plants will die, as happened in compartments No. 37, 40, 41 and 42.

(*e*) *Frost.*—Young plants of *E. rostrata* are not so very susceptible to frost, but heavy frosts kill their tender shoots.

(*f*) *Nilgai.*—In winter when every thing else in the plantation is either leafless or brown, the green foliage of the Eucalyptus attracts the *Nilgai*, which bend or break a goodly number of young plants to get at the leaves. At other times, however, the tree has no particular attraction for the animal as there is ample green fodder all over the

plantation. To keep them out of the young Eucalyptus areas, fencing is necessary. In Chhanga Manga a three strand barbed wire fencing in the first three years has proved fairly effective for the purpose.

6.—*Natural regeneration.*

It is too early yet to talk of the natural regeneration of any of the Eucalyptus so far tried in the plantation but passing reference may be made to a few trees felled in C. 60 at the time of final felling in 1929-30. As already mentioned in Section 2—History, these trees were planted in May 1913. After the final felling in the winter of 1929-30 the area was cleared of all brushwood by burning, trenched, sown with *shisham* seed and irrigated. About the middle of April 1930 the stumps of the trees which had been felled, were noticed to coppice freely, and in the course of weeding the *shisham* lines about the end of the month a number of Eucalyptus seedlings were observed around them. The coppice shoots are now about 25 feet and the seedlings about 15 feet in height; and they appear to be mostly *E. rostrata*. With this example of the natural regeneration before us, one may safely say that, given opportunities, this species will easily establish itself in Chhanga Manga. It will be interesting to mention here that *Eucalyptus rostrata* starts flowering at the age of six years and that 8 years' old trees seed profusely.

7.—*General.*

It is not known yet what use the wood of *E. rostrata* will be put to when the time to exploit it arrives. The tree is known to produce good timber though it requires to be converted green, or there is much waste from splitting; and there is nothing against its use as firewood. Consequently there is a hope that a steady demand for it will spring up once it is placed in the market. The development of Eucalyptus oil industry in course of time is another probability.

Other Eucalypts which have been tried are :—

E. tereticornis.—Can be easily raised in nursery from seed, but 90 per cent. of the cuttings planted in compartment 56 failed. Pot planting has not been systematically tried. In the first three years growth is slow. From the description of the species given by Parker it is a useful tree and well worth trying.

E. rudis.—Grows well in nursery. Cuttings were tried in compartment 37 but failed on account of inadequate irrigation. Its wood is of poor quality hence cultivation of it has been abandoned.

E. paniculata.—A good timber tree but is difficult to raise from seed or cuttings. Was tried in compartment 56 but failed. In nursery only 10 per cent. of the seed germinated.

E. crebra.—Good for timber. Germination of seed in nursery pots was 50 per cent. Pot planting was done in compartment 56 but all the plants were killed back by frost. Not suitable for Chhanga Manga.

One very important aspect of the introduction of Eucalyptus in Chhanga Manga which will come up for consideration in the near future is the treatment of the mixed crop of Eucalyptus, *shisham* and mulberry which has resulted from it. The Eucalyptus is fit for use as firewood in five years' time when it will have attained an average girth of $1\frac{1}{2}$ feet at breast height. During the same period *shisham* and mulberry will only be ready for 1st thinning. So far there will be no trouble as the Eucalyptus can be cut at the time of 1st thinning. That will, however, mean the end of it in the crop as there is hardly any chance of the regeneration succeeding under the shade of the other two species, particularly mulberry. The alternative is to treat the Eucalyptus crop independently of the other two species and to exploit it on a short (say eight years) rotation, the associated species being clear felled at the same time for whatever they are worth ; and this method will certainly ensure the natural reproduction of Eucalyptus from coppice as well as from seed. The effect of the over-head cover of the Eucalyptus on *shisham* and mulberry has also to be determined.

The following table gives the average girth measurements at breast height of Eucalyptus plots grown in the plantation :—

Plot.	*Age.* Year	months.	No. of trees measured.	Average girth.	Remarks.
Range Office Compound.	2	4	104*	1′—$\frac{3}{4}$″	In July 1928.
Range Office Compound.	5	8	95*	1′—11$\frac{1}{4}$″	In December 1931. Flowered in 1930.
Compartment 25.	..		..	..	Forest Research Institute sample plot. Flowered in 1930. Cuttings planted in March 1926.
Compartment 60.	15	3	38	3′—3$\frac{1}{3}$″	In July 1928. Felled in January 1930. Coppice and seedling regeneration now on the ground.

* It seems that besides 40 cuttings of *E. rudis*, referred to in paragraph 2 under History, other plants were planted at the same time.

SUCCESSION AMONG THE GRASSES OF THE DECCAN TRAP DRY MIXED DECIDUOUS FORMATION AND ITS USE IN SUB-CLASSIFICATION.

By E. A. Garland, I. F. S.

Dr. Burns has described his experiment in grassland improvement (1) mainly with reference to its practical results in increasing carrying capacity. Its ecological results, however, confirm in an interesting manner the results of field work recently carried out for the revision of the Working Plan for Poona Forest Division. A brief description of this division was published recently in the " Indian Forester," (2) and it is only necessary to emphasise here the fact that, due to the position and physical configuration of the division, there are chains of hills running from west to east which retain a fairly constant altitude above sea level, uniformly based on Deccan trap, but with a steady decrease of rainfall along each from over 200 inches in the west to less than 30 inches in the east. Absolute accuracy in measuring the rainfall is not possible, owing to differences which are bound to exist between precipitation on the hills and at towns, and villages, in the valleys where the rain gauges are located, and owing to the fact that there are only 26 recording stations in the division. But the general range of rainfall can be estimated with a reasonable degree of accuracy and for practically every locality within that range, owing to the configuration of the hills, there is a mesophytic site on the northern slopes, and a xerophytic site on the southern slopes. Moreover with varying degrees of slope, and soil depth, different stages in the succession can easily be recognised. Thus for the whole range of rainfall it is possible to find localities displaying most of the primitive stages of " normal " succession from bare rock, that is to say the pri-sere, wherever the slopes are sufficiently steep to have excluded exploitation by man and grazing by his domestic animals ; while on gentler slopes there are to be found a vast variety of sub-seres and stages of retrogression started by past exploitation, and since conservation mainly according to whether the areas are open to grazing, temporarily closed, or permanently closed. Many of the permanently closed areas have been kept for grass cutting and all grazing excluded since pre-British times. These are in the drier half of the zone with rainfall from about 60—30 inches and the static condition of the vegetation, under a treatment which consists solely of harvesting

the grass annually at the close of the monsoon, is remarkable and apparently represents, in natural vegetation, a similar state of affairs to that found in agricultural crops, where a perfect balance has been reached between the requirements of the crops harvested and the natural processes which recuperate fertility. (3) Given the time, ability and facilities for research, therefore, very important results could be obtained as to the development of vegetation on Deccan trap under all climatic conditions especially if the biotic factors were controlled. Even with limited opportunities a combination of inspection and stock-mapping, with correlation of existing vegetation found under the various known conditions of rainfall and restriction of grazing, has demonstrated that there are certain definite developments which occur and which can be described, if the examination is extended as far as possible to the vegetation as a whole, and not merely confined to the particular growth form "trees." In this connection, as pointed out by Prof. Troup (4) and others, the grasses have proved to be particulary useful. And it seems that the appearance and disappearance of certain species of grasses can be co-ordinated with the natural invasion and subsequent development of the tree species. The results so far obtained are necessarily only tentative, but seem to be sufficiently reliable to justify further investigation, and at any rate to suggest the basis upon which it may be possible to evolve a reliable sub-classification, which would be valuable for management purposes.

The normal colonisation of Deccan trap by vegetation appears to follow the same primitive stages for the whole range of climate represented by annual monsoon precipitation of between about 60 and 20 inches of rainfall, and can be tabulated as follows:—

(1) Much bare rock and earth thinly covered with *Aristida* species and some *Andropogon contortus*. *Andropogon monticola* is gradually taking hold in crevices behind stones and on similar sites where soil can collect. There are a few xerophytic bushes and shrubs.

(2) *Andropogon contortus* and *Andropogon monticola* spread, the former occupying the greater part of the site, with *Aristida* species still present. There are bush, shrub and dwarfed tree species all under six feet in average height. At this stage lantana is very apt to become strongly invasive. *Apluda varia* begins to appear under shrubs and bushes.

(3) The average height of the tree species increases up to 12 feet. *Boswellia serrata* is frequently the only, or principal representative. Shrubs and bushes may, or may not, spread over a large part of the site. *Aristida* species disappear and *Andropogon contortus* is now co-dominant with *A. monticola* and *A. pertusus*, *Apluda varia* spreading considerably as a sub-dominant.

(4) The average height of tree species now goes upto 20 feet, of which teak is often the principal on reddish soils and *Anogeissus latifolia* on friable grey soils. Tree canopy is beginning to form on the more favourable sites along incipient nullahs, but the species are still limited. *Andropogon contortus* is now definitely dominated and *A. monticola* and *A. pertusus* are now co-dominant with *Ischaemum laxum* or *Ischaemum sulcatum*.

(5) There is a marked increase in the natural regeneration of varied tree species, especially of *Terminalia tomentosa*, in spaces between the groups of trees, which are now upto 30 feet in average height steadily beginning to suppress the shrubs. *Anthisteria ciliata* begins to appear and *Andropogon contortus* disappears.

(6) Closed tree canopy of all mixed deciduous trees with a general average crop height of 30 to 50 feet, though open glades are still common where *Anthisteria ciliata* is usually strongly dominant. Shrubs have disappeared and bushes are generally suppressed.

Owing to interference by biotic factors, such as past exploitation, fire and grazing by domestic cattles, it is impossible to state with any accuracy where reduction in annual precipitation of rainfall becomes limiting. But it appears that even with from 20 to 40 inches closed tree canopy would eventually be found, though the component species would be few and the canopy would always be sufficiently open for the grasses to continue vigorous existence on the forest floor, while with from 40 to 60 inches the upper canopy would be much denser, further above the ground level and composed of many more species, bushes of more or less evergreen habit forming a considerable lower horizon or stratum.

Such a normal development of the vegetation would explain the state of the forest lands when taken over for forest conservancy and also goes a long way to explain the difficulties which have been experienced in past

management. At first removal of the tree growth in the 20—40 inch rainfall zone would have encouraged the growth of valuable fodder grasses, particularly with a little burning, which would tend to keep down any *Anthisteria ciliata*. But the simultaneous reduction in soil moisture, through decreased supply of the leaves essential for synthesis of humus, and exposure to the sun during the hot weather rendering conditions unsuitable for the activities of the essential fungi and bacteria, would quickly throw back the succession to the early stages where the possibility of re-invasion by tree species was strictly limited and where in any case their development, especially in height growth, was dwarfed and stunted, a condition in which continuous grazing has kept the succession ever since, even though further exploitation of the tree growth has been stopped Dr. Burns' experiment is, therefore, of particular interest because it has demonstrated that progression towards the normal climax can be restarted simply by controlling the grazing on a rotational system and checking erosion, whereas total exclusion as noted earlier, has merely maintained equilibrium. It also follows that restoration of active progression amongst the grasses is an essential preliminary for satisfactory development of a forest crop, which will not be achieved either by natural or artificial means unless the soil is in a state which it will demonstrate by the production of certain grasses, the last and highest of which is *Anthisteria ciliata* immediately proceeded by *Andropogon annulatus* and *Ischaemum sulcatum*. Also since the two latter happen to be the most valuable fodder grasses produced in this zone, forest management can assist itself in gaining its object up to this stage and assist the grazing interests at the same time, a point in economics which carries its own inferences.

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(3) The Waste Products of Agriculture, their Utilization as Humus. By A. Howard and Yeshwant Wad, page 38, Oxford University Press 1931.

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REGIONAL SURVEY

AND ITS RELATION TO STOCK-TAKING OF THE AGRICULTURAL AND FOREST RESOURCES OF THE BRITISH EMPIRE.

BY RAY BOURNE, M.A.

OXFORD FORESTRY MEMOIRS NUMBER 13.

(*Clarendon Press, Oxford: Price* 15/- *net*).

From the somewhat lengthy title the reader does not easily obtain a clear idea of the main idea or object of this work. In the introduction we read:—"The determination of the correct methods of stock-taking forms the problem of primary importance in the forests of the British Empire," and again "the need for investigating new methods of assessing local conditions must be recognized as of the first importance" and the object of the present work is defined as suggesting the most practical methods of carrying out scientific assessments of local conditions.

The unit of area of assessment is a "site" which the author defines as "an area which appears, for all practical purposes, to provide throughout its extent similar local conditions as to climate, physiography, geology, soil, and edaphic factors in general" and the identification of sites gives a practical solution of the problem. The problem can, however, be greatly simplified by approaching it from the "regional" standpoint. A region is defined as an association of sites; so long as several recognisable sites alternate with each other we are in a region, but when many or all of the associated sites cease to recur from some particular point or boundary, and an altogether new set of sites is found, a different region or type of country has been entered. A simple example may serve to illustrate this. The Gangetic plain has a number of associated sites, *e.g.*, good culturable land, *usar* plains, broken ravine country, *jhils* and water-logged areas, etc., which form a region. But travel north to the Himalayas or south to the rocky hills of Central India, and these sites vanish to be replaced by altogether different series of types. We have travelled

into different " regions." As the author remarks, the idea of dividing a country into regions is of course almost as old as the hills which are such a striking feature of some regions. So we must look further to see what new ideas or suggestions the author has to make.

More than 150 out of 170 pages of this book describe in great detail an experimental survey, carried out by the author, stretching from Burford to Little Marlow, a distance of about 50 miles. It was essentially a geological-cum-botanical-cum-aerial survey, and the author was assisted by a geologist, an agriculturist and an aeronaut (Capt. C. R. Robbins of Burma aerial survey fame). Throughout the work particular emphasis is laid on the importance and value of aerial survey " Knowing something of the value of aerial photographs as maps, and realizing how clearly the aerial view from a sufficient elevation shows a country to be divided into scenic regions, the writer recognized that the co-operation of the aerial surveyor was not only desirable but essential." And again " Air Survey in this and other directions presents altogether new facilities." The book is illustrated by 12 excellent aerial photographs or mosaics of the Burford-Marlow country surveyed. We entirely agree with the author that aerial survey is invaluable in land assessment *up to a certain point.* Probably the most striking example of intensive land assessment in the world is provided by the periodic revenue settlement operations in the Gangetic plain. Here we find millions of acres of cultivation divided up into tiny holdings, with many millions of fields of one or two square chains in size—very seldom even an acre—where *every field* has to be mapped and measured and classified into one of several soil qualities for the correct assessment of rent and land revenue. It will possibly be news to the author of the book under review that the work of mapping the hundreds of millions of fields, which formerly took an army of surveyors years to do, is now very often done far more quickly and far more accurately by aerial photography, and in recent settlement operations in the United Provinces, whole districts have thus been mapped. Simultaneously such aerial mapping differentiates the associated sites of the region, and (to a less extent) even the different agricultural crops.

The advantage of aerial survey in intensive land assessment is thus already an established fact, but there are certain limitations, which the author does not mention in his book; due to the comparatively small scale of 50 miles on which he worked possibly he did not recognise them.

Let us again take the Gangetic plain as an example. As regards topography, geology and soil, a thousand miles or more would form a "region." But throughout that great stretch *the climate is a gradually varying factor,* from the damp humid conditions of Bengal, with rice and jute as the staple crops, to the deserts of the Punjab, impossible of cultivation without irrigation. How can such a zone be divided into regions? There is no hard and fast boundary that aerial or ground survey can distinguish, no one mile—no particular 50 miles—will indicate the slowly altering climate and the resultant slowly altering region. In short the author, while emphasising the importance of regional survey, has not touched on the problem of defining regions which are an integral of climate.

Foresters will recognise the importance of regional survey in scientific forestry, it is the foundation of periodic stock-taking and of preparation and revision of working plans. The author states that the methods which foresters have devised and adopted in locality assessment have proved seriously inadequate, and as a result the primary need of forest management has not been met, so that silvicultural practice and forest policy have constantly been based on uncertain foundations. He writes:— "There are enormous areas within the Empire in which the forest vegetation has been so modified by man, for instance through the agency of fire, that the true relation of vegetation to climate and soil may be largely obscured. There is little doubt that many types of forest in both temperate and tropical climates have been mistakenly considered to represent the climatic optimum, though admittedly modified by biotic or other factors. Evidence is not lacking that shifting cultivation, unrestricted grazing, and fire can completely eradicate the natural species of a climatic region. Even if the resultant vegetation is forest, it may bear no resemblance to the true climatic climax type. Only extended scientific survey, involving intensive studies of vegetation in relation to local conditions, can establish what is the climax forest vegetation for any area." The invasion of evergreen into sal forest with fire protection is a probable example, but we cannot see how an aerial or any other form of survey could have indicated what would happen in the moist type sal forests when fire protection was first introduced by the early generation of foresters half a century or more ago.

Here and elsewhere throughout the book, the author stresses the *intensive* nature of the study and survey which he considers essential,

which implies a fairly high cost and a fairly long time per unit of area. And then he urges the adoption on the hugest possible scale. "While remembering the extent of the areas to be covered, the limited staff available, and the need for the co-operation of various scientists in the field, it is impossible to resist the general conclusion that the time has more than arrived for the organization of a scientific survey of the Empire. The survey should embrace not only forest land but all land, and is as necessary at home as abroad. The idea of sending scientific expeditions fully equipped to explore the farthest corners of the earth is already established. The need for doing very much the same thing in settled and partially developed countries has yet to be grasped. In spite of the immensity of the task such a project should be taken in hand as a set subject and a programme of work drawn up for a period of years. Though some individual units of the Empire may be so placed that they can carry out their own programmes without outside assistance, collectively they must all benefit by collaboration, and many must depend upon co-operation with others if they are to deal effectively with common problem. In any case the matter is one which calls for a marshalling of scientific resources and an Imperial Policy."

This, we think, is the weak point in his book. While an intensive survey is justified in highly developed and intensely cultivated lands, where the annual produce is of great value, how can the wider and less valuable areas of the Empire—thorny scrub deserts, inaccessible mountains, impene rable tropical evergreen, the barren and forest lands of the Arctic—how can these financially justify intensive (and expensive) study and survey, involving "Regional Survey assisted by Air Survey and based on intensive researches in sample areas?" But although we think the author has attempted to cast his net too wide, we commend the book to all who are interested in the economic resources of the Empire and their assessment and determination.

E. A. S.

EXTRACTS.

THE IMPORTANCE OF PLANT VIROSES.

(Extract from an address by Sir John Russell, O.B.E., F.R.S., on "The Changing Outlook in Agriculture" published in *Nature*, December 19th, 1931).

Among the most serious troubles of modern times are the virus diseases of plants. These diseases are apparently not caused by any recognisable living organism, nor are they simple physiological disturbances; they cannot yet be attributed to any definite causal agent. They spread rapidly, being frequently carried by small insects, sometimes by mere contact, and they cannot be cured—one can only stand by and see the plants perish.

All kinds of crops are affected; sugar-cane, tobacco, cotton, sugar-beet, groundnuts, bananas, potatoes, maize, timber trees (for example, sandal), large and small fruits (for example, peach and raspberry), and most greenhouse and horitcultural plants. Moreover, it is not so much sickly plants as healthy ones that suffer. In Gambia the Rosetta disease cut down the crop of groundnuts to about one-third of the normal yield. In the United States in 1926 two virus diseases reduced the crop of potatoes by no less than 16 million bushels. In Great Britain the total loss cannot be estimated, but the figures recorded for various attacks vary from 35 to 75 per cent. loss of crop. Worse still is the deterioration of stocks: stocks apparently healthy and vigorous may become worthless in two to four years. Cotton growers are becoming seriously perturbed. In the Gezira last year the losses were considerable, although until recently the leaf-curl disease was unknown there. Sugar-beet in the south-western region of the United States is so seriously imperilled by the curly-top disease that the Government has set aside 300,000 dollars for its investigation. In England special grants are made to Rothamsted, Chestnut, Bangor, and other institutions to study these diseases. Tobacco is now being badly attacked, also tomatoes and potatoes; the latest sufferers are the narcissi and daffodils in our own gardens; these cease to flower and shortly perish. Virus diseases are quite recent as serious plagues; if they are old, they have hitherto been unimportant or unnoticed. Clearly, Pandora's box is not yet empty.

DEATH OF MR. G. M. RYAN, F.L.S.

It is with deep regret that we record the death of an old friend and contributor, Mr. George Michael Ryan, late of the Forest Service of India, who died at his residence in London after a short illness on the evening of the 8th January last. No death could have been less expected, for though Mr. Ryan was born as long ago as on the 22nd September, 1859, he was in possession of exceptionally good health. Very abstemious in his habits and fond of exercise in the open air, he often used to say that he hardly knew what it was to have a pain or ache of any kind, mentally and physically he was vigorous and alert, and then owing to a stroke he passed peacefully to his rest in a few days.

Mr. Ryan, on obtaining his appointment to the Forest Service in 1883, was posted to the Bombay Presidency. He received, it is believed, several rewards for passing in Indian languages, but it was in Sind and in connection with Sind problems that he brought himself prominently to notice. Sind has an area of 53,166 square miles and a rainfall so scanty that for agricultural and silvicultural purposes it is practically negligible. It is only by means of the waters of the Indus and the fertile silt carried by river floods that cultivation is possible. The State forests have an area of about 17 per cent. of the total cultivated area of the province, and in yield proved to be remarkably productive, but Mr. Ryan, a zealous forester, claimed that they might be far more remunerative with a better embankment system. The river embankments, constructed by the Public Works Department, hugged the course of the stream too closely and prevented much forest land from being brought under flood influence. In forest interests Mr. Ryan pressed strongly for a change in policy, and it is possible that his views might have commanded more respect if the long-continued controversy over the Sukkur Barrage Scheme had not barred the way to the improvements he had at heart.

Into that controversy Mr. Ryan was inevitably drawn, and his studies on the spot forced him to the conclusion that Dr. Thomas Summers and the several able and experienced engineers who supported him were right. From that standpoint he never wavered to the end. Mr. Woods, who wrote the best exposition on the subject in all its bearings, was of opinion that the barrage was a very bad mistake, it was very expensive, it was not wanted, and it was a menace to the safety of the Indus. On the menace question the engineer-critics generally did not say that an avulsion of the

river was certain, they merely said that a barrage, not being needed for the irrigation of Sind was an unnecessary obstruction and a danger; but Mr. Ryan went further than the engineers, and in his article in *The Indian Forester* on "The River Indus and the Best Method of Embanking It" he explained why, with the Indus in Sind in a changing deltaic condition, a barrier across its path was likely to be attended with disastrous consequences. Mr. Ryan was always great on floods and, as our readers are aware, he frequently urged the importance of an International Commission to investigate and advise on the prevention of calamitous floods on the great alluvial rivers of the world. He did not confine himself to India, but with his knowledge and his love of Sind, it is probable that the Indus was never absent from his thoughts.

The late Mr. Ryan retired from the Forest Department of India in 1914, after a service of thirty-one years, virtually a young man. It is not known whether he was a Christian Scientist, but he conducted himself on the principles of that belief. With supreme faith in the power of the mind over the body, he never admitted that it was possible for him to be ill and he never was. In England he seemed to have taken on a new lease of life and soon earned a reputation for his scientific treatment of trees. It was his view that trees are very longlived, and, though they may possibly die from old age, it is much more often from disease. There may be inadequate leaf-functioning due to abnormal accumulations of carbon or dust, or lichen and algae; there may be defoliation from insects, attacks from fungoid disease; waterlogging of the soil or soil exhaustion; there may be all sorts of things, but the point to remember is that a sick tree is sick, not necessarily dying, and that the competent tree-doctor is capable of saving it. Mr. Ryan's researches and practical work won him the support of the authorities at Kew, and he was soon employed all over the country. Trees may be very valuable from their historical associations or because from their age and beauty they grace ancestral lawns, and owners, whether the State or private individuals, are eager that they should be saved and in good health for as long as possible. Dr. Ryan, in his capacity of a tree-doctor, attended his tree-patients in public parks, private gardens, or it may be in isolated places, with astonishing success and a growing practice. He liked the work, it kept him, as he said, on the tramp, in the open air, often in beautiful spots, and there was always time for his literary occupations on his return

home in the evenings, where he would not be disturbed late at night because a tree was in dreadful pain.

And that was not the only thing he did. It is believed that he was in communication with the Army authorities in India about a scheme for the manufacture of alcohol from forest produce by a cheap process for purposes of military transport. His mind was of great fecundity and he had many ideas. He attended all the lectures of the Royal Society of Arts and interested himself in a variety of scientific subjects. He was often to be seen in the tea-room of the Society, entertaining his guests and animating them with his conversation. In serious arguments he was never irritable nor angry, and kept his temper even when his opponents lost theirs. In short, he was a good and loyal friend, he liked to keep his friends, he visited them in sickness, bringing perhaps some little present with him, but bringing always an atmosphere of cheerfulness and no sense of gloom. There are many friends who will feel the poorer by George Ryan's death as they had felt the richer by his life, and as we miss him so will they.

Indian Engineering.
30th January 1932.

30th January 1932.

EMPIRE TIMBERS FOR DECORATIVE AND BUILDING WORK.

From time to time during recent years the Imperial Institute has furnished information to architects and others in regard to timbers derived from overseas countries of the Empire which can be recommended for decorative or constructional purposes in public and other buildings and in private houses. The interest in such timbers for use either as alternatives to the standard woods (mostly foreign) hitherto employed almost invariably for these purposes, or as materials affording a welcome change in appearance and character from the established woods, is steadily increasing, and it has been considered that an account of some of the suggestions made in this connection by the Imperial Institute might usefully be published. Acknowledgments are due to Major Ralph, J. Holliday, M.C., Mr. E. Locks Latham and Mr. H. Stainton Tireman (Timber Adviser to the High Commissioner for India), who are members of the Imperial Institute Advisory Committee on Timbers, and to Mr. E. Bryan Latham and Messrs. Wm. Mallinson and Sons, Ltd., for further particulars kindly supplied by them.

A few preliminary remarks on the rise of Empire timbers in commercial and public favour may not be out of place. Architects and builders are commonly regarded as showing a strong conservatism when considering proposals for the use of timbers to which they are not accustomed, and a similar reluctance to engage in business in new woods has hitherto been attributed to the timber trade. So far as this attitude is correctly ascribed to the interests mentioned, it must be recognised as being founded on the most rational basis. Timber merchants cannot be expected to take unlimited risk in introducing new timbers which they are aware will be avoided by their average customers because the woods are novelties ; while architects, regarding the interests of their clients and their own reputation as matters of primary concern, have declined to risk the use of timber of whose behaviour in practice they have no experience, and regarding which it has been difficult to obtain reliable information.

Strong effort has been made during the past fifteen years to free the interested parties from this deadlock. The Imperial Institute Advisory Committee on Timbers, established in 1916, has this object in view, and other outstanding factors which have contributed to the present changed position of affairs are the action taken by the Government of India, with the co-operation of Messrs. W. W. Howard Bros. & Co., to market selected Indian woods ; the publication of the report on Indian Timbers by the Imperial Institute Indian Trade enquiry (1921) ; the Empire Timber Exhibition (1920), organised by the Department of Overseas Trade, which was remarkable for the display of Indian decorative woods ; and the timber sections at the British Empire Exhibition at Wembley (1924-25). More recently , the Empire Timber Exhibition at the Imperial Institute (1928), which coincided with the publication of the " Descriptive List of Some Empire Timbers recommended by the Imperial Institute Advisory Committee on Timbers "* ; the Report on Timber by the Imperial Economic Committee (1928)† ; and exhibitions of Australian woods organised by the High Commissioner at Australia House, as well as displays of Empire timbers at trade exhibitions, have played their part in the movement. As the outcome of the report by the Imperial Economic Committee above mentioned, the Forest Products Research Laboratory at Princes Risborough is now devoting special attention to the develop-

* Obtainable from the Imperial Institute, London, S. W. 7, price 2s.

† Cmd. 3175. Obtainable from H. M. Stationery Office, price, 9d.

ment of the use of Empire woods. For the most part this official work would have been impossible and fruitless but for the co-operation and initiative of the timber trade. The results achieved to date afford a good example of what can be accomplished by a combination of official and commercial effort; while a number of enterprising architects and builders have given the final and essential impetus to the movement by the pioneer use of selected woods recommended to them. It is satisfactory to state that, to date, no failures of any material importance appear to have been reported.

The experience which has now been gained regarding a useful selection of Empire woods enables satisfactory replies to be given to the questions necessarily asked by prospective users. The timbers are establishing themselves on their merits. The decorative woods offer a wide range of choice in attractive and even handsome appearance. Practically all the timbers now coming into use are satisfactory in working qualities when once any special characters are understood by the workmen (in which respect the new woods differ in no way from the woods in standard use); in this connection it may be mentioned that a good range of Empire timbers is now used as routine material by the staff mechanics at the Imperial Institute for constructional and decorative work. Supplies and prices are reasonable although, in general, the choicer decorative woods are not cheap and find their natural and best outlet in good or high-class work, a statement which is not intended to suggest that the use of the woods is feasible only for expensive undertakings. It is no detriment to Empire timbers to urge the importance of careful selection, and insistence on guaranteed completeness of seasoning when purchasing supplies. For all high class work such precautions are taken as ordinary procedure in regard to foreign timbers, and Empire woods require similar consideration if justice is to be done to them. There is, however, no difficulty in obtaining satisfactory material from reliable timber merchants.* Prospective users desire to inspect examples of the employment of the timbers in practice. Samples of the woods and some instances of their use may be seen at the Imperial Institute, and certain timber merchants now maintain show-rooms displaying the use of the woods for panelling, joinery and flooring. Special attention, however, is drawn to the register of notable

* Information as to sources of supply of the various timbers dealt with can be obtained on application to the Director, Imperial Institute, South Kensington, London, S. W. 7.

examples of the use of Empire woods for construction and decorative purposes in public and other buildings which is maintained by the Empire Marketing Board. The register is available for consultation on application to the Secretary of the Board. A few notable examples of such use are mentioned below.

Reference may here be made to the fact that, at the instance of the Imperial Institute Timbers Committee, application was made to the London County Council for a small number of Empire timbers selected by the Committee to be submitted to the official tests of the Council with a view to their inclusion in the list of timbers mentioned in the Schedule of the London Building Acts, (Amendment Act), 1905, as fire-resisting materials. The following woods have been accepted by the Council as fire-resisting: Andaman Padauk; Crabwood and Mora from British Guiana; African walnut and Iroko (African teak). An additional number of very useful timbers has thus become available for essential structures of buildings.

The following pages contain suggestions as to timbers of Empire origin which can be employed with satisfactory results in the construction of public and commercial buildings and private houses. The principal uses for which timbers are suggested are panelling, staircases, joinery, flooring and carcassing. The woods are not described in detail. Characteristic features are usually given and fuller particulars will be found in the "Descriptive List of Some Empire Timbers recommended by the Imperial Institute Advisory Committee on Timbers (1928)." A further publication dealing with Empire woods is to be issued by the Empire Marketing Board. No reference is made below to English home-grown timbers, such as oak, brown oak, walnut, ash or elm, whose qualities are widely recognised.

Timbers for Panelling.

A useful number of Empire woods form admirable materials for panelling. Selected timbers are highly decorative and sufficient experience has now been gained with them to show that they stand well and are entirely satisfactory for the purpose. It is strongly recommended that the timbers be used as veneer upon an approved backing, preferably a plywood or laminated backing.

INDIAN TIMBERS.

A measure of the decorative and practical value of the fine series of Indian woods introduced in recent years is afforded by the importance of the buildings in which they have been freely used for panelling and other purposes. The most notable instance of such use is India House, Aldwych, and special mention may also be made of the Bank of England in Finsbury Circus, and the offices of Imperial Chemical Industries, Ltd. At India House, extensive panelling, which is probably unrivalled as concerning the respective timbers, has been carried out in Laurelwood, Burma Padauk, Silver Greywood, White Bombway and Kokko. All the timber used is in veneer mounted on a backing of Moulmein cedar (*Cedrela toona* Roxb.), a wood of proved merit for this purpose. Fine workmanship has enhanced the beauty of all the timbers used, but special reference may be made to the results obtained with figured Burma Padauk, Laurelwood and Kokko. Notes on the woods used will be found below.

A small but instructive example of the use of Indian woods for utility and decorative purposes is afforded by the new series of cases for panoramas shown in the Indian Section of the Public Exhibition Galleries of the Imperial Institute, where Gurjun, White Chuglam, Teak, Silver Greywood, Andaman Padauk, Indian White Mahogany and Kokko have been successfully used for panelling and joinery.

Indian Laurelwood (*Terminalia tomentosa* Wight and Arn). One of the finest and most beautiful of the new Indian timbers. It bears a general resemblance to walnut in colour and figure, but the character of the wood is distinctive and attractive on its own merits. It is hard and difficult to work and needs careful selection and matching, but is worth all reasonable trouble and expense. The panelling constructed in this timber for the Central Hall of the India Pavilion of the British Empire Exhibition, 1924, when the timber was used in veneer on a backing of Moulmein cedar is an example of the proved successful use of the wood for the purpose. Sections of this panelling, shown at the Timber Exhibition at the Imperial Institute in 1928 by Messrs. W. W. Howard Bros. & Co., were in perfect condition.

Burma Padauk (*Pterocarpus macrocarpus* Kurz) is closely related to the more striking and better-known Andaman Padauk, from which it

differs chiefly in its more subdued reddish-brown colour. The figured material is of exceptional beauty and dignity, and must be regarded as one of the best panelling timbers available. The wood takes an excellent polish and has good technical qualities, although it is hard and a little difficult to work.

Indian Silver Greywood (*Terminalia bialata* Wall.). An ornamental timber with a bold figure, which renders it specially suitable for large panels. The varying colour (yellowish-grey to grey-brown) is one of the characteristic features of the wood ; the tones have little or no resemblance to stained "greywood," but are quite permanent and render the wood a useful substitute for the popular walnut. The working and polishing qualities are satisfactory, but care is needed in gluing. The wood is now being used by the London, Midland and Scottish Railway Company for the internal decoration of "luxury" coaches. It is suggested as a useful alternative to the walnut at present so much used for the panelled backgrounds of shop windows. The panelling of the Georgian Dining Room of the India Pavilion at Wembley was a notable instance of the use of this wood.

White Bombway (*Terminalia procera* Roxb.). This timber is as yet little known in this country, but is an attractive decorative wood which works and finishes well. It is a lustrous yellowish-grey to light brown wood, often with darker streaks, and is close and even grained. It is comparatively cheap and supplies a decorative material for less important work.

Kokko (*Albizzia lebbek* Benth) is a handsome lustrous brown timber showing a considerable variety in colour and markings. Finely figured material with parallel bands is available, as is shown in the remarkable panelling in this wood at India House. Kokko is hard, has a fine texture with somewhat open pores and stands well. It needs careful finishing, but an excellent surface and polish are obtainable.

Andaman Padauk (*Pterocarpus dalbergioides* Roxb). The handsome dark crimson variety of this timber is often beautifully figured and forms a decorative wood of the first class, though the more brightly coloured timber does not suit all tastes. The colour, however, mellows with time to a fine golden brown, and useful examples of the appearance of the wood after 30-40 years' standing are afforded by the fittings in All

Saints' Church, Paddington, and the panelling of the Jehangier Hall at the Imperial Institute, South Kensington. A fine effect is produced in suitable cases when panelling in this timber is relieved with ebony mouldings or beadings. The timber is officially recognised as fire-resisting.

Teak (*Tectona grandis* L.). The decorative value of selected teak is not fully recognised, the familiar more or less plain variety usually being regarded as expressing the full extent of the ornamental capabilities of the wood. The selected timber used in constructing the new show cases in the Indian Section of the Imperial Institute illustrates the value of even moderately figured wood. Highly figured material, however, is also available and is one of the most ornamental timbers for high class panelling. Objection is sometimes raised to the characteristic odour of freshly worked teak; the smell is not permanent and should not be regarded as a drawback to the use of the wood for internal work.

White Chuglam (*Terminalia bialata* Wall) is a pale yellow-grey mottled wood with good and easy working qualities. It stains and polishes well and is very satisfactory for light-coloured panelling and for ornamental structural work.

Gurjun (*Dipterocarpus* spp). A pale reddish-brown timber of bright, clean appearance which works excellently and polishes well, especially good results being obtained with a dull " egg-shell " finish. It is chiefly known as a flooring wood and has been little used for panelling, but is well worth attention for this purpose.

East Indian Rosewood (*Dalbergia latifolia* Roxb.) This fine decorative wood is perhaps too dark in colour for prevailing fashion, but it should be considered for use in special cases, as it is one of the most ornamental timbers available.

East Indian (Ceylon) Satinwood (*Chloroxylon swietenia* DC) is too well known and valued to need more than mention.

TIMBERS FOR STAIRCASES.

At both the Empire Timber Exhibition (1920) and the Wembley Exhibition (1924) specially constructed staircases were among the most important examples of the use of Empire woods for structural and decorative purposes. Staircases offer special opportunities for the use of a variety of timbers in consequence of the varying requirements for different parts of the structure, *e.g.*, the carcassing, ornamental panelling,

turnery, carving, stair treads and risers. For all these uses it is possible to recommend Empire woods as entirely satisfactory. At the Exhibitions mentioned, Andaman Padauk and Indian Silver Greywood were used and found very successful both as regards appearance and standing qualities. Most of the woods recommended above for panelling would also be found suitable for the decorative work and turnery of staircases; Andaman Padauk, Burma Padauk, Indian Laurel, figured Teak, Burma mahogany, Kokko, the African and Honduras mahoganies, Queensland walnut, Silky oak and Nigerian walnut are specially suggested. For treads and risers Gurjun, Canadian maple, and Australian blackwood and Jarrah may be mentioned. Jarrah, Karri and British Guiana Mora (*Dimorphandra Mora* Benth and Hook), are specially adapted for the treads of staircases subject to hard usage.

Special attention is called to the fine results obtained with Andaman Padauk for carved balusters and newel posts. The beautifully carved balusters surrounding the gallery in the central hall at India House have been carried out in a pale variety of the wood, and it is difficult to overstate the decorative effect.

For certain types of staircases fire-resistant woods are essential. In this connection reference is made to the timbers mentioned above as having been recently approved by the London County Council as fire-resistant: teak, jarrah and karri are similarly accepted.

Timbers for Joinery.

Timbers, both hardwoods and softwoods, satisfactory in all respects for the main types of joinery, *viz.*, doors, windows, sashes and sills (as well as for office and similar heavy fittings), may be obtained from Empire sources, and the usual requirements for materials for high-class work, medium grade and cheaper work can also be satisfied. A series of eight high-class double and single doors, designed by distinguished architects and manufactured by Messrs. Holloway Bros. (London), Ltd., from selected Empire woods was shown at the Imperial Institute, Empire Timber Exhibition. 1928, and illustrated the suitability of the following woods for the purpose: Andaman Padauk, Indian Silver Greywood, White Chuglam, Indian Laurelwood, Indian White Mahogany, White Bombway, Kokko and Nigerian Walnut. Other timbers suggested for similar classes of work are: Indian rosewood (used for the front doors

of India House), Andaman Padauk (inside doors at India House), Australian blackbean, Australian walnut, Silky oak and Burma mahogany, in addition to mahoganies.

For doors of good appearance and capable of hard usage Burma teak, White Chuglam, Honduras mahogany, British Columbia Douglas Fir and Iroko are recommended. Doors made from the first three timbers mentioned and intended for use in public baths and hospitals were exhibited by Messrs. Holliday and Greenwood, Ltd., at the Exhibition already mentioned.

Among Indian woods, Teak is a well-known flooring timber with excellent wearing qualities, and Andaman Padauk may be similarly described with additional reference to its striking appearance. Kokko has also been used for flooring, Gurjun and Kokko are the flooring timbers used at India House. Both are excellent materials for the purpose. Gurjun is especially durable and can be worked to a fine lustrous surface. It is relatively silent in use and is well adapted for ball-rooms. Indian Laurelwood and Silver Greywood have also been used for flooring in private houses. Examples of parquetry floorings made from most of these timbers were shown by Messrs. W. W. Howard Bros. & Co. at the Imperial Institute Timber Exhibition, 1928.

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IRRIGATED SHISHAM PLANTATIONS IN THE PUNJAB.

BY BAHADUR SINGH, P. F. S.

The dry *rakhs* of the Punjab, which covered several million acres area during the middle of the nineteenth century, formed the main source of firewood supply to the North Western Railway, the Indus Steamers and the general public. The *rakhs,* the arid scrub forests, contained scattered trees of *jand* (*Prosopis spicigera,* Linn), *karir* (*Capparis aphylla,* Roth), *van* (*Salvadora oleoides,* Dcne) and *farash* (*Tamarix articulata,* Vahl) ; and the vast treeless areas served as grazing grounds for horned cattle and browsers. The supply of wood to the railways and steamers reached a crisis during 1864, when these *rakhs* were hardly able to meet the growing needs of the time. With the coming of the canals the *rakhs,* which were only waste and unproductive, were converted into arable lands of great value. Thus, the Province produced more food for the people by bringing large areas under the plough, but reduced the wooded areas which had to supply them with fuel. To meet the shortage of wood a scheme for an irrigated plantation matured during 1866, when the famous Chhanga Manga plantation was started. This plantation reached maturity during 1881-82 and supplemented the fuel supply of the *rakhs* until 1905, when the locomotives started the use of coal instead of firewood. The demand for firewood by the railway having thus disappeared a corresponding increase took place in the use of wood by the population of new towns which had sprung up with the extension of irrigation under the colonization scheme. The wood-bearing areas of the *rakhs* dwindled

with the spread of colonization from $6\frac{3}{4}$ lakhs acres in 1894-95 to a little over 96,000 acres in 1929-30. Out of 96,000 acres, 84,000 acres of the Montgomery Forest Division are being colonized and their disappearance is only a matter of a few years. Such an enormous decrease in the wooded area of the Punjab plains forests threatened a serious wood famine ; and the Government, having realized the situation, agreed to the establishment of eight plantations, including Chhanga Manga, covering in all 81,000 acres.

Apart from Chhanga Manga (12,523 acres) which is in its fourth rotation, one, Chichawatni (11,539 acres) is under final fellings, two, *viz*:—Khanewal and Daphar, (19,290 and 7,219 acres respectively), are just coming into bearing, and the remaining four are still in course of formation. Of the last four, the fate of Miranpur (9,820 acres) is hanging in the balance for want of water supply, while the conditions of two, Arafwala and Dipalpur (9,000 acres each), are not free from anxiety for reason of the shortage of water supply on the Sutlej Valley Project.

Assuming that all plantations, including the above three which are at present suffering from want of an adequate water supply, come into bearing, the estimated annual yield of firewood from 81,000 acres will be about 20 million cubic feet stacked. Lahore alone, the premier town of the Province, requires 17 million cubic feet stacked firewood on a population basis estimated at 2 seers fuel per diem per head, and the rest of the important towns of the Punjab plains districts, excluding all such towns as are dependent for fuel on the surrounding low hills (*viz*. Rawalpindi, Jhelum, Attock and Umbala), will need annually another 63 million cubic feet stacked. In calculating these figures all towns having a population of 10,000 and below have been omitted. Conservative as these figures are, a comparison between supply and demand is a matter which calls for serious consideration. At present, there is an enormous quantity of wood already in stock and still to be cut from areas being colonized on the Burala Extension and Sutlej Valley Projects ; but in a couple of years' time when the existing stock is exhausted, the position is bound to become worse and the

A dry *rakh* used as grazing ground consisting of *jand* (*Prosopis spicigera*) *karil* (*Capparis aphylla*) *van* (*Salvadora oleoides*) and *farash* (*Tamarix articulata*).

country will be facing a serious firewood famine. In Indian domestic economy, firewood is as necessary a commodity as food stuffs are. Electricity or oil cannot be an economic substitute for wood in this country where people have no means to resort to a mechanical heating process.

This explains the position of towns, while the condition of rural areas is none the less serious. Here, the bulk of the population depends upon agriculture, and for cooking their food the people burn cow-dung for want of wood and thus destroy a valuable manure which would otherwise have added to their prosperity. The necessity of making fuel reserves is, therefore, equally important both for urban and rural areas.

Apart from the main consideration of the firewood supply which they are designed to fulfil, the plantations provide the public with *shisham* (*Dalbergia sissoo*) and mulberry timber for making houses, furniture and sports goods; such as tennis racquets, hockey sticks and cricket bats. A considerable quantity of grass is annually sold to villagers, and, in case of drought, several thousands of cattle are kept alive on the fodder and leaves available from the plantations. Solution of the non-employment problem is another boon which the plantations confer upon quite a large number of workmen and staff. This number depends on the size of each plantation. A standard 10,000 acres plantation provides employment to 200-230 men daily and, in addition, to 30 members of permanent and temporary staff. On maturity of the plantations, this number increases by about three times. Last and not least is the revenue consideration. The formation of a plantation is invariably combined with cultivation, *i.e.*, the area not required for annual planting is leased out for temporary cultivation and the revenue derived therefrom is credited to the Forest Department. In this manner, the land not actually required for afforestation each year brings in considerable revenue to the Forest department. Dnder this scheme, the cost of afforestation in a one-acre plantation in 15 years' formation period comes to Rs. 135 and gives a return of Rs. 760 per acre *viz*. Rs. 735 from temporary cultivation and Rs. 25 from sale of

forest produce. For details see Appendix I. Thus, after defraying the complete cost of formation, the Government derives a net return of Rs. 625 per acre, which corresponds to Rs. 15,625 per square (25 acres). These figures are based on present day rates and may be taken as a most conservative estimate. Appendix II gives a summary of revenue and expenditure on a one-acre plantation during its first rotation. According to these figures, the surplus works out at Rs. 3 per acre *i.e.*, a 10,000 acre plantation gives a sustained annual surplus of Rs. 30,000 (*Note* :—Sale rates of firewood are based on present day low rates). As the plantation enters into the second or third rotation the surplus per acre increases with the growth of mulberry timber which fetches Rs. 2 to Rs. 4 per cubic foot. Take the case of the oldest plantation, Chhanga Manga, which had worked off the whole balance of the debit against it in 1913-14 and has since been giving a surplus of Rs. 20 to Rs. 25 per acre per annum. Assuming the present day fixed value of the Crown waste land at Rs. 400 per acre the plantation is paying interest at 5 to 6 per cent.

It is believed that plantations do not give the same return as that derived from agriculture. This may be true of the palmy days after the Great War when the price of land was very high, but it may not be perhaps true now. The Government sells the best culturable land and gets compound interest on the investment from the sale proceeds at different rates of interest. While the Forest Department, with one or two exceptions, has had the disadvantage of being given poor lands, of which more than 30 per cent. is either *kallar, rappar* or uncommanded, no colonist would ever touch such areas, of which several thousand acres are still lying unallotted. The Forest Department not only makes use of such unculturable lands, but also pays water rates to the Canal Department. As explained above, the plantations are formed without any expense and at the close of formation period the Government makes, by means of temporary cultivation, nearly as much profit per acre as it would have otherwise made from sale of land to colonists. Once the land is sold, the Government gets only land revenue at Rs. 2 to Rs. 3 per acre on matured area. While plantations pay in the first rotation at Rs. 3 per acre on gross area and

Later transformation of a dry *rakh* into *shisham* plantation with an understorey of mulberry (Chichawatni plantation).

in later rotations at Rs. 20 to Rs. 25 per acre. If a correct account is made of the areas which remain unallotted in an Irrigation Project the plantations will not perhaps fair badly. It must, however, be remembered that whatever the financial aspect of the two concerns may be, the plantations continue to remain the property of the State, giving a sustained revenue and everlasting benefit to the people.

The formation of such a valuable property is, therefore, a national asset of the highest value for the coming generations of the Punjab, and no right thinking person can easily ignore its advantages. The existing areas are by no means sufficient to meet the demand, and in order to avert the coming crisis it is of paramount importance that more areas are allotted for plantations in suitable centres.

To a forester the plantations are none the less important. A glaring contrast between a dry *rakh* and a similar *rakh* transformed into "forest" (as represented by plates 10 and 10A) will give an idea of the technical skill displayed by the forester in making waste and sun-scorched lands productive. The plantations are likely to play an important part in the economic conditions of the Punjab Forest Department in the near future, when they will be contributing a major portion of the surplus. The formation of plantations is verily a work of silviculture combined with the economic use of canal water. The work is of highly technical nature requiring special training in its own line.

APPENDIX I.

ESTIMATED EXPENDITURE AND REVENUE ON THE FORMATION OF ONE-ACRE PLANTATION WITHIN 15 YEARS PERIOD.

(a) *Expenditure.*

		Rs.	a.	p.
1.	Demarcation	0	2	0
2.	Trenching (6″ trenches)	12	0	0
3.	Stocking	2	4	0
4.	Restocking	0	10	0
5.	Weeding	1	0	0
6.	Construction of compartment and boundary roads	1	2	0
7.	Construction of buildings and wells	8	0	0
8.	Construction of main water courses	0	12	0
9.	Repairs to roads and buildings	2	4	0
10.	Reopening of trenches	6	0	0
11.	Canal water rate on 15 acres at Rs. 4/2/- per acre (3 feet delta)	62	0	0
12.	Silt clearing over 15 acres at -/8/- per acre ..	7	8	0
13.	Watering by *beldars* 15 acres at -/5/- per acre ..	4	11	0
14.	Collection of seed	0	3	0
15.	Fire protection	0	8	0
16.	Establishment including proportionate charges of Divisional Office and Divisional Forest Officer's salary	24	0	0
17.	Miscellaneous	2	0	0
	Total ..	135	0	0

(*b*) *Revenue.*

(*i*) **True Forest Revenue.**

		Rs.	a.	p.
1.	Sale of seed and cuttings etc.	0	8	0
2.	Sale of wood from 1st and 2nd thinnings ..	22	0	0
3.	Sale of grass	1	2	0
4.	Compensation and miscellaneous	1	3	0
	Total ..	24	13	0
	or say ..	25	0	0

Net expenditure 135/- minus Rs. 25=110/ per acre.

(*ii*) **Revenue realized from temporary cultivation.**

	Rs.	a.	p.
105 acres at 7/- per acre	735	0	0
Less net expenditure	110	0	0
Net saving ..	625	0	0

The value of land which the Government gets at Rs. 625/- per acre, after defraying the cost of the formation of plantation, works out at Rs. 15,625/- per square (25 acres). This rate compares most favourably for the land sold out in Ganji Bar Colony commanded by the Lower Bari Doab Canal.

APPENDIX II.

ANNUAL EXPENDITURE AND REVENUE REALISED ON ONE-ACRE PLANTATION DURING THE FIRST ROTATION AFTER ITS FORMATION.

(*a*) *Expenditure.*

		Rs.	a.	p.
1.	Canal water rate	4	2	0
2.	Debris burning over 1/15th	0	1	0
3.	Reopening of trenches	0	6	3
4.	Silt clearance	0	8	0
5.	Watering by *beldars*	0	5	0
6.	Repairs to roads and buildings	0	2	6
7.	Fire protection	0	0	6
8.	Establishment	1	9	6
9.	Miscellaneous	0	1	0
	Total ..	7	3	9

(*b*) *Revenue.*

		Rs.	a.	p.
1.	Sale of firewood cut in main fellings :— estimated yield 2,500 cft. stacked, at 5/- per cent. cft. stacked $= \frac{125}{15}$ (based on present market rates).	8	6	0
2.	Thinnings 1st and 2nd, Rs. 22/15	1	8	0
3.	Sale of grass and seed etc.	0	2	0
	Total ..	10	0	0

This will show that during the working of first rotation the plantations give a surplus of Rs. 3/- per acre which is bound to increase in future rotations by the increased revenue realized from the sale of mulberry wood for sports.

"PAGET M. P." LOOKS AT SAL.

Without any previous experience of *sal* forest work, I found myself pitchforked recently into extensive touring of the *sal* belt from the dry Saharanpur Siwaliks in the west to the humid *tarai* of the Bengal Assam border in the east. Remembering the old adage about fools rushing in where angels—and even conservators—fear to tread, I sit back and gasp at my own temerity in attempting to write up *sal*. But the onlooker sees more of the game than the players, and it is only by each of us adding a small quota to the total of our experience of the forest that such baffling problems as *sal* regeneration can be met and solved. It is, therefore, not in any spirit of criticism that I have written the following notes.

There has recently been some correspondence from Messrs. Davis (1) and Chaturvedi (2), advocating that we should find the cure for our *sal* problems by imitating the natural ecological development of the *sal* forest and encouraging a middle story of miscellaneous species in mature *sal* forests. This sounds all right, and is doubtless theoretically correct, but in view of the fact that the department has spent the last sixty years in ruthlessly removing any "inferior" tree species from the *sal* bearing forests, it is going to take a long time to readjust the balance. Where *sal* has been left in undisputed possession of the ground for so long, and particularly in the drier half of its geographical distribution where it is virtually a climatic climax formation, the chances of introducing a miscellaneous understory under established *sal* is very poor indeed, unless we are prepared to tackle artificial work of some kind. But if we accept the need for cultivation of the soil to introduce a nurse crop, why not "go the whole hog" and cultivate *sal*? If we are prepared to follow the classic but rather dilatory methods of the French oak woods, we can doubtless obtain a good understory of miscellaneous species naturally in, say, 60 years, and in the course of a further 60 years we might conceivably obtain good *sal* regeneration under such a nurse crop. But is such a programme likely to be approved by the men that hold the purse-strings? It seems to me that we shall be forced, whether we like it or not, into some form of intensive

cultivation in order to regenerate *sal* and any other marketable species which does not yield immediate results in its natural regeneration.

The remarkable success which has been achieved in Bengal in raising *sal* and several other valuable species by means of *taungya*, and also by means of departmental plantation work with field crops, when for some reason the *taungya* villagers cannot be persuaded to settle, is not sufficiently appreciated. In the United Provinces a start has been made in Gorakhpur Division (3), where labour conditions are ideal, but in some other parts the adverse labour conditions and a rather Micawberish reliance upon *sal* regeneration "turning up" have both acted as a drag upon the development of artificial methods.

When the enthusiasm for the shelterwood method became the fashion about 15 years ago, it was unfortunate that the method of heavy seeding fellings was not more fully tested on an experimental scale before launching out into working plan revisions which entailed the transfer of all the best *sal* areas, generally speaking about one quarter to one half of the *bhabar* and *dun sal*-bearing forests, into conversion working circles, in all of which Periodic Block I has been heavily felled over. Curiously enough the earlier work was more successful than the more recent fellings, as Smythies in his excellent summary of *sal* ecology has pointed out (6). To take the example of Ramnagar Division, a typical *dun* valley formation, the earlier attempts at heavy seeding fellings produced a quite presentable show of regeneration mostly from coppice, but in subsequent years, from 1924 onwards, the deadly combination of deer browsing, frost, and fire, plus the repeated cutting back of all advance growth to obtain "regularity" in the young crop, has resulted in a dismal regularity of failure. The same holds good in other divisions where they are nearing the end of a working plan period, having made heavy regeneration fellings throughout most of their P. B. I., and having lost much of the advance growth or established regeneration which had previously been present.

In a most interesting and vital paper in the last number of the Empire Forestry Journal (4), Dr. Watt calls attention to the failure

Fig. 1. Young sal pollarded at breast height by persistent sambhur browsing. Kailkhur, Ramnagar Division.

Fig. 2. Close-up of a single sal stem in a regeneration area where advance growth has been coppiced 10 years ago to obtain "regularity," and since persistently browsed by deer. Bandarpani, Ramnagar Division.

of university-trained foresters in the application of the highly complicated regeneration systems of continental practice through attempts to imitate the *form* of regeneration fellings without a real understanding of their import. Is not this just what has been happening in the United Provinces *sal* forests? The tentative experiments in heavy seeding fellings of 1908 to 1918 had not completed their experimental stage when they were seized upon and applied with ruthless enthusiasm to all the best *sal* forests of the province. As Dr. Watt says: "The Philosophy of Action implies the existence of a set of rules already worked out and according to which the action is performed. The work done is not an expression based on the understanding of the system, but is carried out merely in accordance with it. Its devotees are disciples, not students; enthusiasts, not authorities. They accept the system without question, for questioning means delay." It seems to an onlooker that the United Provinces *sal* regeneration problem has foundered, not so much through any individual's mistakes, as through this urge for "action at any cost" which has influenced the whole department.

To cut out the sermon and return to individual items in the problem of the three enemies, frost, fire, and deer browsing, all of which menace young *sal* in different degrees throughout the province, deer browsing appears to be the one most readily controlled by man, and yet it is deer browsing which is largely responsible for the present lamentable condition of many of the best *sal* forests. The accompanying photos (1 and 2) taken in the Kailkhur and Bandarpani blocks of Ramnagar Division are not by any means isolated instances of such damage. As the game warden of the country it is surely possible for the Forest Department to regulate the incidence of *shikar* activities so that the deer do not get so completely out of hand as to become a first class forest pest. By the partial or complete protection of tigers and leopards in the affected districts for a period of years we would possibly antagonise some influential *shikaries*, but we could regain some popularity amongst the majority by encouraging and organising beats for the killing of chital and sambhur. Had this been done some years ago instead of sticking religiously to the conventional game laws, there

would probably have been less cause for pessimism over the fate of *sal* regeneration areas at the present moment, and less need for the enormous expenditure on the miles of deer-proof fencing which are now being erected.

To turn to the question of artificial regeneration, which has become the immediate problem in the restocking of the thousands of acres in which seeding fellings have failed, the use of the tea planters' cover-crop *boga* (*Tephrosia candida*) is now being tried on an experimental scale in the United Provinces. Its value as a preventer of weed growth in the lines between *sal* sowings has already been recognised in Bengal, where in Kurseong Division it is sown regularly along with the last agricultural crop of the *taungya* cutters (or in the departmental cropping of jute where villagers will not settle in the forest), (see fig. 3).

The use of *boga* promises well, and good *sal* seedling crops have already been raised along with it in the United Provinces Silviculturist's plots in Lakhmanmandi (Haldwani Division)—(fig. 4), and in the Institute experimental plots in Dehra Dun (5), but a word of warning might not be out of place. Like most cover crops, *boga* is likely to be a good servant but a bad master, and particularly in the drier *sal* areas where it is not so common naturally its introduction might easily become a nuisance in much the same way as the rapidly spreading *Lantana*. Further, the enthusiasm for growing a good cover-crop may become too much of a hobby, if the subordinate staff is allowed to think that a good cover-crop is a quick route to promotion, independent of the fate of the *sal* sowings which it is designed to protect. In Bengal it has been found that the *boga*, which grows into a straggly bush 7—11 feet high, has to be thinned and pruned drastically if it is not to suppress the *sal* seedlings, even where the *sal* has a year's start. If left to itself the *boga* will die out in the course of a few years, particularly when the *sal* lines are close together and a *sal* canopy is formed early. On the other hand if a dense crop of *boga* is required, it can be coppiced back for several years in succession, provided always that the stumps are cut over a little higher up in each subsequent year, *e. g.*, first year of

Fig. 3. Two-year-old sal with a single row of *boga* sown by the cultivators just before they leave the area. Kudalbusti, Buxa Division.

Fig. 4. One-year-old sal sheltered by a dense mass of *boga*, both sown in June 1931. U. P. Silviculturist's Plot, Lakhmanmandi, Haldwani Division.

cutting back, 3″ above ground ; second year, 6″ ; third year 9″, and so on.

The latest custom in Bengal and in the Central Silviculturist's Dehra Dun plots is to sow a single line of *boga* between the *sal* lines which are 6 feet apart, whereas the United Provinces Silviculturist's interesting plots in Lakhmanmandi indicate that the interline spaces should be broadcast with *boga* sowings up to within a foot of each side of the *sal* lines, thus giving a very much denser crop of *boga*.

These broad cast sowings yield a plant of quite different habit of growth from the single-line sowing type ; the latter should be easier to deal with in regulating the amount of shade for the *sal* seedlings. Whether the more westerly *sal* requires so much denser a cover-crop to afford it more side shade has yet to be determined by experiment under forest conditions, as the present Lakhmanmandi experiment is on a small scale and carefully fenced against both deer and porcupine. In Bengal the *boga* is up and seeding in its first year while in United Provinces it does not seed profusely until its second year.

The usual rôle of a cover-crop is to protect and conserve the soil in the open lines between the main crop, preventing excessive weed growth where weeds are luxuriant, and also preventing dessication of the soil where a weed or grass covering is absent. Both conditions are met in *sal* work ; the common need is something to check the heavy weed growth, particularly the coarser grasses, but in the Gorakhpur *taungya* areas where plains *sal* has been successfully raised, the bare and impoverished condition of the soil between the elder *sal* rows points to the urgent need for additional cover. This might be met by an extensive use of *boga*, but its introduction into plantations which have already been deserted by the *taungya* cultivators would of course entail some extra expense, as soil working would have to be paid for. In areas still under cultivation, however, the *boga* can be sown cheaply by the *taungya* cutters along with their last agricultural crop. A characteristic of this poor quality plains *sal* is the very long time it takes to form a close canopy from line sowings and at present 10 feet is the smallest width that the cultivators will agree to work with.

When discussing cover-crops it is as well to remember that *boga* is not by any means the only possible one. In Bengal *boga* is suspected of exhausting the soil moisture at the expense of the young *sal* and for work in the western *sal* belt some indigenous species would probably be more suitable. Some leguminous species is indicated, owing to the legumes' useful habit of increasing the available nitrogen content of the soil. The blue lupine (*Lupinus hirsutus*), (which is used in Scotland a great deal as a green fodder crop in forest nursery work), and the common yellow *Crotolaria* (*C. sericea*) of the United Provinces *bhabar* tracts, are both very similar to the *boga* in appearance and habit of growth. This *Crotolaria* occurs gregariously over large patches of open ground, notably in the Patkot block of Ramnagar Division, and where it is established it effectually keeps out grass and other more dangerous weeds. It is conceivable that this *Crotolaria* or some other similar locally common leguminous plant would be worth while cultivating on the same lines as the *boga*. The problem of restocking artificially the large areas in which heavy seeding fellings followed by browsing and fires have almost exterminated the *sal*, will have to be tackled immediately, and whether the work is done by means of *taungya* or by departmental cultivation, there will be a need for a suitable cover-crop either to nurse the *sal* sowings or to keep down the weeds.

After hearing and reading so much pessimism on the subject of *sal* regeneration, I have been agreeably surprised by the healthy and prosperous condition of the majority of the *sal*-bearing areas of the hill working circle or selection working circle type. Where no attempt at regular working has been made, the long continued conservative selection markings have produced a very fair imitation of the text-book selection forest. The *sal* regeneration, though locally scanty, is generally speaking good enough to give gradations of all the younger age-classes sufficient to meet the needs of the case. The two main dangers for this type of forest appear to lie in (1) the marking rules, and (2) the deer browsing incidence. If it is accepted that these forests should be retained under a scientific selection system, and that attempts to force them into an even-aged condition should be discontinued, the *sal* may be depended on to do much of its own thinning. Particularly

on the *bhabar* slopes where the rapid changes in the level of the underground water-table are liable to cause many casualties amongst the older trees, a good reserve of younger trees must be maintained, so that blanks will be filled up by recruitment from the younger age-classes. This has already been realised, and the tendency in most places seems to be towards more conservative marking amongst the younger stock in uneven-aged stands.

As for (2), the deer browsing incidence, I have already given vent to vandalist theories which will doubtless bring the *shikaries'* heavy fire onto these notes, but in these days of popular shooting excursions and keen competition for shooting blocks it seems sadly unscientific that as a department we cannot put our house in order when some temporary manipulation of the game rules might meet the case.

R. M. G.

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(4) A. S. Watt. Empire Forestry Journal X, 2, of December 1931.

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A LESSON FOR INDIA.

BY SIR ALEX RODGER, O.B.E.

In the "Times" of January 26th appears a letter from the A. P. W. Bamberger which is full of interest for those who desire to see the forest products of India taking their proper place in the markets of the Empire. This letter is printed in full on pages 263-65.

Those of us who have had to deal with the marketing of Indian woods, especially hardwoods, during the last twenty or thirty years, have been frequently impressed by the evidence of the handicap which these woods start with when competing with similar woods from other countries. Except in a few cases, sawmill work in India and Burma is very much below the standard attained in Europe and America. The ordinary sawmill is frequently roughly and incorrectly built, the sawbenches and saws are improperly adjusted and the result is that the outturn is frequently of varying dimensions and irregular section. Far from being sawn into an immense variety of sizes and "with almost microscopic accuracy" the ordinary products of Indian sawmills are often of very rough surface and variable outline, so that the consumer does not know what he will get, and has to waste a good deal of his purchased material in recutting and planing. If this is important in the case of soft woods, is it not still more important in the case of hardwoods?

"Material that would otherwise be treated as waste is in Europe converted into a range of small dimensions at corresponding low prices."

Where can we find this done with even the most valuable Indian hardwoods, except in a few large well-managed mills?

It is probable that a demand for small sizes can be worked up for many species, but at present one can often see even *sal* timber wasted unless it produces one of a very few standard sizes.

Much research in the use of Indian and Burmese woods has taken place recently at Dehra Dun, in Burma and in Madras, and it only needs a small effort on the part of millers to make use of the scientific experience of the forest officers to make their mills pay much better than they are doing at present.

The second point is "subjecting the goods to careful seasoning before shipment."

We are dealing with a climate which is far harder on timber than any part of Europe. Extremes of heat and cold, dryness and moisture, make it imperative that timber should be properly seasoned before being offered to a buyer. Several consignments of timber which have arrived in London have created a most unfavourable impression because they were loaded either green, or in a wet state during the monsoon, and timber which earns a bad name in this way will take years to live it down. Scientific seasoning, preferably in kilns if they are not too expensive, but anyhow in properly built sheds, will do much to remove this reproach, and if this is combined with proper sawing and a knowledge of some (not too elaborate) system of grading, Indian hardwoods should take their proper place in the markets of the world. But an effort is required and continuous propaganda on the part of forest officers. It should not be impossible for Utilization Circles to prove by practical demonstration that clean, well sawn, seasoned timber will fetch double the price of the stuff that is now so frequently offered, which is supposed to be "Good Enough."

TIMBER FROM ABROAD.

(English Requirements).

Sir,—I represent the third generation of my family in the London timber trade, and my firm has interests in the softwood, the hardwood, the plywood, and the English (native) timber trades. I feel qualified to attempt to clarify the position of British Empire softwoods in relation to European softwoods, particularly as my London firm specialized for a considerable number of years before the War in Canadian woods, and is still actively interested in Australian and Canadian hardwoods and softwoods.

Recent correspondence might lead your lay readers to suppose that the softwood importing trade of England is lacking in imperial sentiment and is unduly pro-European. Nothing can be farther

from the case, and any sentiments, either uttered or implied, which impugn the Empire spirit of timber importers are greatly to be regretted, as no more patriotic body of men exists. Were it possible for the Empire to supply the total requirements of the United Kingdom, and when it is possible, as I hope one day it will be, none would be happier than they.

But what is the position to-day? British Columbia, which I know well, is the chief source of supply of Empire softwoods. Before the War considerable quantities of softwoods were exported from the St. Lawrence, but the post-War pulpwood boom caused the majority of the producers of spruce to close their sawmills and go over to pulpwood. The chief softwoods of British Columbia are Douglas fir and silver spruce, and efforts have hitherto been chiefly directed towards popularizing Douglas fir in this country as a substitute for European yellow deal. But the properties of these two woods are dissimilar, and Douglas fir is at present not as freely accepted as a substitute by consumers as we all would wish. British Columbia's chief markets being the American Continent, the Orient, and the Antipodes, the main specification she produces is strange to United Kingdom consumers. Admittedly a few of the English standard dimensions are produced, but they only touch on the fringe of this market's everyday requirements, and even these few are very often unobtainable.

Against this, England has the European softwood production at her disposal from Sweden, Finland, Russia, Norway, and the lesser Baltic States. Most of these countries export at least two species of softwood timber, *i.e.*, yellow deal (redwood) and whitewood, and saw this material into an immense variety of sizes and with almost microscopic accuracy, subjecting the goods to careful seasoning before shipment. Material that would otherwise be treated as waste is in Europe converted into a range of small dimensions at correspondingly low prices. Needless to say, it has taken many generations for the European trade to organize itself to its present elaborate state, and until such time as Empire producing centres are similarly organized they will be labouring under a disadvantage which patriotism may to some extent overcome, but not entirely. With regard to Russia,

Russian and Siberian softwoods are fine goods. The forests are old, the texture of the wood is mild, and admittedly much of the timber is of exceptional quality.

There has recently been no dumping of Russian wood, because the trade has organized itself to defeat dumping, and the proportion of Russian imports to other European imports was approximately the same for 1930 as for 1912. With respect to stocks of European softwoods at present in this country, it should be remembered that at the beginning of the year stocks from ice-bound ports should necessarily represent from six to nine months' supply.

Finally, I would remark that the timber trade of England is to-day the largest raw material importing trade in the United Kingdom, or one of the largest, and the softwood importers are, with very few exceptions, middlemen pure and simple. They are an open-minded body of patriotic Englishmen, engaged in a highly specialist and highly competitive trade, and their main duty is to serve their customers. They will, I am convinced, continue to urge their clients to purchase Empire woods, as I and my firms are continuously doing, but until such time as the Empire is in a position to cater adequately for the United Kingdom demand in all its complexities they will, unfortunately, have to look largely to other sources of supply.

A. P. W. BAMBERGER,
(Louis Bamberger and Sons.)
27-28, Finsbury-square, E.C.2.

A VISIT TO SOME OF THE GAME RESERVES OF SOUTH AND EAST AFRICA.

This visit was not made with any special purpose of studying the game of this part of Africa but formed part of an ordinary "rubber-neck" trip through the Union and parts of Southern Rhodesia, Tanganyika and Kenya.

Perhaps the most striking feature of the trip is the ease with which it can be done. Rail and motor car take one practically everywhere and without the need of camping out for a single night though, if one particularly wished to see the rarer sorts of game such as elephant and rhino, it would be necessary to camp out for some days in most parts.

Starting at Durban we put ourselves into the hands of the South African railways tourist bureau for the trip through the Union and South Rhodesia. Being the complete "rubber-necks" we allowed the bureau to make all arrangements for hotels as well as tickets; and the arrangements were excellent and everything went like clockwork.

The drawback to thus fixing a definitely dated programme is that one cannot vary the length of one's stay in any place without throwing out the remainder of the programme; and we would advise anyone making a similar trip not to make a dated programme but to get the bureau to arrange for all the rail and motor tickets, so as to gain the very substantial saving on the cost of the rail tickets and to adopt their recommendations as to hotels, while arranging oneself for the actual booking of dates. At the same time one has to remember that many of the trains do not run every day, so that unless one studies the time table pretty carefully one may find oneself marooned at some dismal junction. Whichever way one elects to do the trip one can count on great help and courtesy from the railway staff wherever one goes.

Our first visit was to the Natal national park in the Drakensberg. This park contains little in the way of game at present as it has only been recently constituted and the game, which has almost been shot out in the surrounding country, has not yet learnt the safety of the park nor begun to breed up again. Still the place is well worth

a visit for there is a comfortable hotel and very fine scenery ; while for those who like trying to break their necks on rock climbing there should be risks to suit every taste on the cliffs of the Drakensberg.

Making our way down to the Cape we passed the Addo reserve, which has just been taken up this year, and went on to the Knysna forests, in both of which places there are the last herds of elephants to be found in the Cape Province. They are rarely seen in the latter area, for the forest is very dense and naturally at the time at our disposal we could only stick to the beaten track.

The guide books make much of the scenery of the Knysna forests, but it must be confessed that we did not see anything to rave about. There is much of botanical interest, but most of us can remember much more picturesque forest country in India or Burma.

The most important of the Game Reserves in the Union is the Kruger National Park ; and to our mind it is certainly one of the best things to see in the Union. For quantity and variety of game and the certainty of seeing it, this park excels any that I have yet seen in other national parks.

One might call it a reversed Zoo where the animals look at the human beings in cages and bolt when the humans leave their cages ; just as the humans would do in an ordinary Zoo were the animals to escape.

It is unnecessary to rehearse all the species that we saw, but with the exception of elephant, rhino, buffalo and one sort of buck we passed every species shown in the list so far as I can remember ; and had we chosen to spend more time in the park we could no doubt have seen the remainder.

Perhaps the most impressive feature is the enormous numbers of some species. Wildebeest, the gnu beloved of the cross word puzzle, were to be seen literally in hundreds, and impala in herds of a dozen to thirty occurred every few miles upon the road. One began to realise how it might be possible for the reserve to hold some eight hundred lions as it is estimated to do ; and certainly the lions we saw

were of the picture book type for fatness, and carried muscle to a degree surprising to one who had never seen a lion except in a cage.

It is certainly a curious sensation to be able to stop the car within some thirty yards of a pair of lions and stay peacefully there while both parties study each other.

The car is the secret of the success of the reserve. The animals seem to attach no importance to the car and take no notice of it while it is moving. When it stops they become slightly suspicious and may move away slowly but usually allow one quite a good view of them. Any attempt to leave the car sends them off at once, as also any commotion such as attempts to get one's camera to bear on them from the car. For this reason the ordinary type of hand camera with mirror view finder is practically useless, one should have a frame and aperture view finder; but even so it is unlikely that one would get anything like good photographs without a first class telephoto lens. A cine-camera might do better, but probably not in the hands of the ordinary globe trotter.

As usual, if one wants to carry away photographs of the game there is a fine supply of first rate ones to be bought, far better than the average amateur could hope to take.

A pass to enter the Park costs £1 per car; and it is important to remember that these passes are only issued at the gates of the park and not by tourist agencies as formerly. There are also three or four ferries to be crossed according to the route taken, and the charges for these have also to be paid at the ferry and are not included in the pass. Owing to the rains the park does not open till the 15th May; and even then the growth of grass is rather too heavy. Probably late June and July are the best months.

Visitors may only camp at the three or four recognised camping grounds where sleeping huts are provided, nominally at any rate on account of lions. Although the lions appear so well-fed and comfortable the rule that no one is to sleep outside a camp is probably sound. The night before our arrival at the head quarters camp a party of lions invaded the camp and two of them indulged in a real good

fight for the charms of one of the lionesses of the party. The occupants of the camp that night are not likely to grumble at the rule in future.

Our trip took us from Nelspruit, at the S. W. corner of the park where we left the train, to the headquarters camp at Sabi bridge for the first night, and on next day to Satara camp, and thence through Letaba camp out at the N. W. gate to Leydsdorp.

All the camps have sleeping huts with charpoy bedsteads, but not much else in the way of furniture, though this is being remedied. Washing arrangements are inadequate at all the camps and it is certainly advisable to take a bucket along with one, if not a basin as well. Lack of funds has prevented the National Park Board from taking up this matter properly in the two seasons that the park has been regularly opened to tourists, but a start has been made.

This is certainly the weakest feature about the park organisation and the one most likely to affect overseas tourists.

One can get meals at Sabi bridge where there is also a store ; and at Satara there is a store owned by the company which has leased the catering for the park. At Letaba there are no supplies except petrol, fuel and water.

Actually unless one is set on seeing elephant which are only found N. E. of Letaba in a part which has hardly been opened out for tourists, there is not much reason to camp anywhere beyond Sabi bridge for it is possible to see all the other game inside trips from that camp.

We decided that were we to make the tour again we should go by rail to Koomatipoort, on the border of Portuguese East Africa, and take a car thence to Sabi bridge for the chance of seeing buffalo on the way, stay at the latter for a day or two, and leave by way of Nelspruit.

To leave as we did by Letaba takes one through a longish stretch of uninteresting bushveld country till one strikes the railway again. The scenery and game are not worth the extra cost of the motor journey.

Certainly no one visiting the Union ought to miss going to the park and for the tourist, conditions will certainly improve year by year.

Southern Rhodesia did not show us anything special in the way of game beyond what we had already seen in the Union, more especially as the hippo above the Victoria Falls have been shot off for giving trouble to the boat traffic ; nor did we see anything on our way to Beira where we were marooned for a week. There both the British and Portugese treated us as strangers and took us in, the former biblically, the latter colloquially.

Yet Beira has its consolations, the chief of which is its golf course which has the finest turf of any low country course in the tropics, and achieves it by putting the course completely under water twice a year with sea water from the adjoining mangrove creeks.

Thence on to Tanganyika where we were again unlucky in not seeing elephant in the heath forest on Killimanjaro. Several beasts had been through the forest the night before along the track we followed. It was surprising to us to find elephant so high up as 8,000 feet, and in forest which seemed to have little for them to feed on but it is evident that the African elephant differs very much in his diet from the Indian.

At about 14,000 feet we came across numerous tracks of the mountain eland, which cross from one side of the mountain to the other over the saddle between the two peaks, but we saw none of the animals themselves.

The next reserve between Moshi and Arusha produced nothing but some ostriches ; nor did we see anything more till we had crossed the Kenya boundary and got into the Masai reserve.

The elephant and rhino which we hoped to see near Longido camp were not on view as it was the wrong time of the year. To make up for this disappointment our driver, an Italian, regaled us with the tale of how one day, when driving along this road, he heard behind him what he took for the hoot of a car and duly signalled to it to

pass ahead. As the hooting continued, but the car still did not pass, he pulled aside and slowed up only to find that he had been waving forward an elephant which had been frightened by some other party and was fleeing down the road behind him. Luckily for the driver it continued to flee.

The road across the reserve must rank as one of the worst in that part of the world though it proudly calls itself the Great North Road and a link in the Cape to Cairo route.

An irate visitor writing to the local paper described himself as having driven along it with one foot on the brake and the other in the grave ; and certainly in the section through the volcanic dust belt at the foot of Mt. Meru the holes in the road are big enough to provide a grave, not only for the driver but almost for the whole car.

The game in this reserve, though not so plentiful as in the Kruger Park, is easier seen as the grass and bush are not so dense, while new species not found further south make the trip worth doing ; but it is decidedly advisable to have a strong car to do it in.

Probably almost as much game would be seen along the motor road from Nairobi to Mombasa, which we gathered was not quite such a test of endurance for the car.

Looking back on the whole trip from Durban to Nairobi we discussed the question whether we should have done better to have followed the plan we first considered, namely, to buy a box-bodied car in Durban and drive right through the whole way. We came to the conclusion that the extra liberty which the car gives one to make side trips would not make up for the long stretches of decidedly uninteresting driving over indifferent roads needed to get from one centre to another.

The driver would need to keep all his attention on the roads, and the passenger finds long miles through bushveld country decidedly monotonous.

Taking it as a whole nothing could beat the climate we enjoyed, and the air of the high veld can be recommended to any one in search

of a non-alcoholic stimulant ; but we confess that the scenery struck us as monotonous. The relatively little change in general character is striking when one considers the variety one would expect to meet with in any other continent over a range of thirty-four degrees of latitude. So we decided that we would not recommend any one to make the Cape to Nairobi trip by car unless they like driving and dust for their own sakes.

That the trip is worth doing there can be no doubt, and since the best time for getting about and *seeing* game is from May onwards in the southern hemisphere the trip should appeal to any one who wants a change from the usual summer leave to Europe.

W. A. R.

THINNINGS IN THE FORESTS OF BADEN

By M. D. Chaturvedi, B.Sc. (Oxon.), I.F.S.

1. An interesting departure from the conventional nomenclature of the various degrees of thinnings has been recently made by Herr. Karl Philipp (1), *Landesforstmeister*, which consists in dispensing with the old and somewhat vague terms like, 'light', 'moderate' and 'heavy', commonly used to indicate the intensity of thinnings in a stand. An attempt has been made to replace this indefinite terminology by what Dr. Philipp calls '*Wirtschafts-Stufe*' (working stage), which provides a definite quantitative measure of the nature of thinnings in a stand. He distinguishes the following working stages (W. S.) :—

W. S. II	Where intermediate	yield	is	20	per cent.	of total yield*
W. S. III	,,	,,	,,	30	,,	,,
W. S. IV	,,	,,	,,	40	,,	,
W. S. V	,,	,,	,,	50	,,	,,
W. S. VI	,,	..	,,	60	,,	,,

2. A knowledge of the total yield of an area is indispensable for adopting these quantitative measures of thinnings. Herr. Philipp's yield tables (2) for the main species of Baden give the necessary information. Thus, all that is necessary is to measure the heights of a few predominant trees in a stand ; reduce the predominant height to the mean height from the table specially compiled for this purpose ; and read against the mean height the total volume of a stand from tables which give total wood production as a function of mean height. Thus, the stand with a mean height of 20 metres would have a total wood production of 600 m^3 per hectare for Scots pine. This eliminates age, since this production is reached in different ages in stands of differing qualities. Now, working stages II, III, IV, V and VI represent the removal of 20, 30, 40, 50 and 60 per cent. of 600 m^3 respectively in total thinnings, and the actual standing volume will be 80, 70, 60, 50 and 40 per cent. of 600 m^3 respectively.

* Total Yield = Final Yield + Intermediate Yield.

3. The basic assumption involved in the construction of these yield tables is that the total wood production in a given quality of locality is fairly independent of treatment and as such nearly constant. The increment, it has been assumed, is constant whatever the grade of thinning, except in the degree II where the increment suffers owing to congestion and poorly developed crowns. This has been amply borne out in Dr. Schwappach's yield tables for beech (3). In its second edition the basal area was reduced to 50 per cent. of the former, without any appreciable decrease in the increment, as a matter of fact the increment obtained was a little higher.

4. An examination of Dr. Schwappach's yield table (1) for spruce, in the light of the standard measures given above, indicates that the sample plots* which he considered *normal* for the yield table were thinned on an average to the working stage II only. The working stage II which is usually obtained by the removal of dead, dying and suppressed trees and other accidental fellings was considered *normal* right upto the nineties in Germany. Later, in his yield table for spruce for Germany, A. Schiffel (5) distinguishes 3 stages of thinnings, and the heaviest grade known as the '*Lichtstand*' corresponds to the removal of 35 per cent. of the total yield and falls between Philipp's working stages III and IV. We find the conception of *normality* undergoing a radical change, and a distinct tendency towards heavier thinnings is noticeable. In the beginning of the present century (1902) Dr. Schwappach's new yield table (6) for spruce was based on thinnings amounting to 46–48 per cent. of the total yield which corresponds to Philipp's working stage V approximately. The *Lichtwuchs-betrieb* (Light Increment) is approximately working stage VI.

5. The working plans now in force in Baden prescribe for stands over 30 years in age thinnings of the working stage IV and advocate that at the next revision of the plans the working stage V would be aimed at. For younger stands the working stage V has been laid down. The rules for thinnings have been very much simplified and leave little

*The yield table was based on 844 measurements of sample plots (403 in the north; 441 in the south of Germany).

room for personal factor after the *élite* trees have been chosen. The chief aim of thinnings is to select the best trees in a stand early and favour their growth right through their life. An attempt is also made to get a two storeyed forest for purposes of protection of soil and cleaning the branches of the *élite* trees in the upper storey. The rules prescribed are :—

Rule 1.—Select the best trees with good crown development* when they are 15-25 years old. The spacing between these *élite* trees varies between 5 to 7 metres, the wider spacing is recommended for fast growing species like Douglas fir ; for beech and oak, a spacing of 5 and 6 metres respectively suffices. Every one of these *élite* trees has a white ring painted round it, and its branches are gradually pruned up to a height of 6 metres. Later on, the fast development of these favourite trees, and the freedom from branches up to 6 metres suffices to distinguish them from the rest and repainting need never be resorted to.

Rule 2.—All whips, topbroken, crooked, forked, diseased, in short, all undesirable trees are to be removed gradually.

Rule 3.—Leave all useful trees. Trees for protection of soil or as a belt against wind, etc., may be left.

Rule 4.—Gradually remove the indifferent trees. Sometimes the indifferent trees form the recruiting stock for *élite* trees in case of an accident to them by snow break, wind break, etc.

6. Thus, at every thinning of a stand one has now to concern himself about the progress of the *élite* trees alone. Once these have been selected, the subsequent thinnings become exceedingly simple, and the procedure passes beyond ' the matter of opinion ' to the ' matter of fact.' The personal factor is eliminated to a large extent and thinnings can be entrusted to the subordinates without any risks. The thinnings are to be repeated every three years. The average size of a division in Baden, being about 9,600 acres, the area to be thinned

*The diameter of the crown should be about 35 per cent. of the height of a tree.

annually is 3,200 acres only. Of course, the interval of thinnings varies with the growth of various species. *En passant*, the rule of thumb followed in Denmark may be briefly referred to here. The interval of thinnings is derived from the digit or digits after omitting the unity from the figure representing the age of the stand. Thus, stands of 20, 30, 40, 60, 100 years of age are thinned at an interval of 2, 3, 4, 6 and 10 years.

7. Thinnings are marked, even if they are unmarketable, and are given away free to the inhabitants of surrounding villages. The second storey is obtained by leaving suppressed trees and sometimes by underplanting. Its function, as has been remarked above, is merely protection of soil, and improvement of trees in the upper storey.

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ASAFOETIDA.

By Amin Chand, Assistant Conservator of Forests,
Utilisation Division, Kashmir.

The asafœtida of commerce, which is known in Indian markets as *hing* or *hingra*, is a gum-resin derived from certain species of *Ferula*. The chief source of the *hing* used in India is *Ferula alliacea*, a plant of Eastern Persia and Khorasan, while the asafœtida of European markets is obtained chiefly from *Ferula fœtida*, a plant which grows in Southern Turkistan, Persia and Afghanistan. Two species of *Ferula* are found growing in Kashmir, *viz*., *Ferula thomsoni* and *Ferula narthex*.

Ferula thomsoni has been found in Kishtwar, Udhampur and Jhelum Valley Divisions and possibly occurs elsewhere, but so far it has not been found growing gregariously nor have any experiments been made to collect its gum-resin.

Ferula narthex (Boiss), which is believed to be the source of true asafœtida, grows wild on extensive tracts in Gilgit District in the Indus Valley, especially in Astore beyond the Kamri and Burzil passes. The plant was first discovered by Falconer in 1838 in Western Tibet, on the Kashmir Frontier, and from the plants thus collected seeds were sent to the Edinburgh Botanic Gardens and thence distributed all over Europe. Sir Walter Lawrence, in 1893, saw the plant in flower in Astore, in exactly the place where it was first seen by the writer four years ago, when samples were collected and sent to Dehra Dun for correct identification.

The plant has a big spongy tap-root; is from eight to ten feet in height, and has yellow flowers. Every part of the plant gives a strong asafœtida smell. It is a perennial plant, the leaves and other above ground parts drying up in the autumn and a new stem and leaves being produced in the following spring. Flowers are produced in May or June according to locality. Lower down, near Astore, the plant flowers in May while higher up in colder places late in June. The time for collecting asafœtida from the stem is June, when the fruit is

yet unripe and from the roots in July and August when the leaves have fallen.

The gum-resin is produced by tapping the plant and as the proper method of tapping was not known, experiments were carried out on both the stem and roots. The stems were first incised vertically just as in the collection of opium, and a small quantity of milk was produced, which was collected after three or four days when dry. The results were not satisfactory. The stems were then completely severed and the cut surface left for three or four days to dry. This gave more milk and consequently more asafœtida. This process was continued weekly until no more stem was left, every new cut being made about six inches below the previous cut. The first cut gave more milk than the second cut and the second cut more than the third and so on.

Experience has shown that the first cut should be made when the plant has flowered and the stems have become quite rigid. If the stem is robust and full grown, a piece of birch bark should be fastened just beneath the cut, before the cut is made, so that the milk which oozes out may fall on the birch bark and not fall to the ground and be wasted. This, however, is only necessary with the top most, *i.e.*, the first cut, as in subsequent cuts the quantity of milk is not sufficient to fall down. The gum-resin dries on the cut surface and when dry is scraped off with a knife and collected in a leather bag or on pieces of birch bark. The dried gum-resin (asafœtida) is about one-third the weight of the milk. During sunshine the quantity of milk exuded is more than on a cloudy day.

Both methods were also tried on the roots and it was found that when the root collar was wholly cut it gave more milk. In this case cuts were made every two inches instead of six inches as in the case of stems. It is not known what injury the roots will sustain by this process and to ascertain this, the roots worked this year have been marked on the ground and will be examined next year. The gum-resin collected last summer was sent to the Forest Research Institute, Dehra Dun, for analysis.

It was stated by the local people that many years ago Pathans from Afghanistan used to visit Astore and collect asafœtida but afterwards they were not allowed to come under Government orders. These Pathans were stated to have collected gum-resin chiefly from the stem by tapping and also to a less extent from the roots by chopping them and boiling them with water, and then evaporating the extract. It was stated, however, that the boiling process did not give good results.

It is estimated that one plant will give about one tola of asafœtida in a year, though rains have a bad effect on the outturn as the milk is washed away. As labour is scanty in Astore and the work was new and experimental the cost of collection has so far been rather high, about a rupee per tola, and it is improbable that it would ever pay Government to undertake the collection of the gum-resin departmentally. It could, however, be developed into a good local industry which would bring some income to the local people and give employment to children and women who could collect the gum near their houses in their spare time, but Government help would be required in the disposal of the outturn.

Asafœtida has various medicinal uses ; it is a stimulant and an antispasmodic and is particularly useful in nervous affections and in hysterical and convulsive symptoms. In India it has been used for centuries as a condiment. In Astore, the local people make a powder of the roots and take it at bed time with a little water in cases of fever. They also eat the green stems cooked as a vegetable with great relish.

REVIEWS.

FOREST ADMINISTRATION REPORT FOR BIHAR AND ORISSA, 1930-31.

Bihar and Orissa has not provided any exception to the inevitable tale of reduced revenue to which we have grown accustomed in our provincial annual reports of recent years. Its revenue for the year under review has dropped under all heads except firewood and bamboos, and shows a deficit of Rs. 73,735. This is of course directly due to the drop in timber output and prices, but also indirectly to the dullness in the mines, which are amongst the forest department's best customers. The deficit is however not so serious as appears at first sight, for there is an outstanding of Rs. 1,96,046 due from contractors who had to be allowed extensions of time for payment of their debts, and this more than covers the deficit figure. Again, there is the item of free grants, totalling Rs. 2,45,000 in value, and of very real commercial value to the community, but which is never shown in the departmental accounts.

As in the Punjab, the Bihar and Orissa forest department seems to be considered " fair game " by the provincial Retrenchment Committee which has recommended a 50 per cent. reduction in the I. F. S. cadre for the province. This may be taken as a clear indication of two things. One is that public opinion considers our department to be top-heavy, and this can only be effectively countered by stringent economy in personnel as well as in works. To quote Mr. Benskin in the annual report : " There is no doubt that the department is overstaffed in every grade and that expenditure has been too lavish in the cause of development. The position of each division has been examined and since the close of the year considerable economies have been effected in every direction ; much more, however, is required before the department can be said to be organised on a sound basis."

The other point is the urgent and increasing need for propaganda and public education as to the vital facts of forestry, so that under the new democracy our case will not go by default. In Bihar and Orissa a step in the right direction has been achieved by the formation

of an unofficial Forestry Association in Chota Nagpur. The importance of maintaining private forests, which represent such a large total area in Bihar and Orissa, on some proper basis of management, is at last being realised, partly as a result of the forest department's work during the last few decades, but more directly as a result of the increasing difficulty in finding good plough timber and building material from private forest areas which formerly yielded unlimited supplies of both. Much, however, remains to be done, and it behoves us to work up a favourable public opinion by means of forestry propaganda and educational work, if we are ever to get a more liberal allotment of funds for forest work from provincial revenues.

A point emphasised by the report is the decline in discipline noticed during the year amongst the lower ranks, reflected in an increased number of fines and dismissals. The far-reaching and insidious effects of the recent political campaign aimed at the breaking down of law and order can thus be seen in our own department, as it is being inevitably felt in every walk of life, making it increasingly difficult to maintain a good standard of efficiency and discipline in any executive post.

Turning to silviculture we find the province as a whole preoccupied with the *sal* regeneration problem, but relying almost wholly upon coppice to replace the crops being felled. Many coppice fellings are in arrears owing to lack of sale, but even so, 13,134 acres of coppice were completely regenerated out of a total coppice felling area of 14,678 acres at a cost of 3 annas per acre, while in conversion working circles we find only 1,023 acres regenerated out of a total of 5,684 acres dealt with at a cost of Rs. 1-0-9 per acre. Our hopes were raised when we read of regeneration commenced in Porahat over 3,680 acres under a "new selection working circle," but on reference to Mr. F. A. A. Hart's plan for Porahat, we find that his regeneration fellings are not under selection, but under a continuation of the previous "conversion to uniform" programme, so presumably "selection" is a printer's error.

In the drier types of forest such as Porahat, coppice regeneration of *sal* is satisfactory but in the semi-evergreen forests of Angul and Puri, success under conversion to uniform is possible only on a very small scale. A new set of nine experimental plots in damp *sal* forest has been laid down with the object of "creating edaphic conditions favourable to *sal*." Under artificial work and plantations the report mentions only teak and *Casuarina* and the only mention of cultivation of *sal* is in Hazaribagh, where wounding of the soil was carried out in conjunction with creeper cutting and thinning, but with little or no effect. The province then is depending entirely upon coppice for its *sal* regeneration. In view of this fact, it is alarming to read of the increasing damage done to *sal* coppice by deer in Sambalpur West and Angul Divisions. As in other neighbouring provinces, the shooting incidence is bearing more and more heavily upon the Felidæ, and with a reduction in their natural enemies the deer are increasing out of all proportion. To take the Bihar and Orissa figures for the four years, 1927-28 to 1930-31, we find the total provincial bag amounts to 179 tiger and 384 leopard, compared with only 35 sambhur and 15 chital. If deer browsing is not to become as great a menace to the forest as it has already done in parts of the United Provinces, some temporary modification of the shooting rules with the object of readjusting the proper incidence of the wild cats as opposed to the deer is surely indicated.

Possibly, however, these fatality figures, which are presumably copied from *shikar* permits, are not very reliable, for a list which includes separate items for "one boar and nine pigs" and again for "seven spotted deer and five chital," to say nothing of the "59 leopards and one panther" of a previous year, is obviously open to suspicion !

Heavy casualties amongst the *Casuarina* in Puri Plantation still give cause for worry. As they occur chiefly amongst the older plantations towards the sea, these may be due to fluctuations in the water-level, and investigations are being made to verify this. The trouble was at first put down to acidity in the soil, but this has been definitely disproved.

The department's policy as regards lac cultivation has been considerably altered. There are now five lac farms run by the forest department as demonstration areas where the findings of the Lac Research Institute at Namkum will be applied.

R. M. G.

IMPROVEMENT OF WOODLANDS.

By W. E. Hiley, Country Life, Ltd., London, 1931, pp. 250+viii with 16 photographs and 5 figures, with a chapter on how to combine Sport with Forestry by the Hon. N. A. Orde-Powlett.

This is a popular book written primarily for estate owners, particularly those possessing estates with an acreage of woodland relatively small but still big enough to warrant systematic management. To some extent, in fact, the book may be looked on as a simplified version of the author's valuable 'Economics of Forestry,' published in 1930, written for a different public possessed of little professional knowledge of forestry but a keen personal interest in it. As such the book is admirable, and should further the interests of forestry in Great Britain particularly where it sets forth clearly the great value of proper forest management in meeting taxation and death duties. The chapter concerned with this subject and that on combining sport and forestry will probably be found by many readers in India to be most interesting and informative. Otherwise, it must be admitted that it is of too localised application to be important to us here.

H. G. C.

EXTRACTS.

BURNING ON AREAS TO BE PLANTED WITH TEAK.

BY DR. IR. CH. COSTER.

The burning on the areas which are to be stocked artificially, is a common practice on Java. Although the whole world over this practice of burning the vegetable waste is widely in use, especially in the tropics and in the peat soils of the colder climates, no comparative researches into its effect on the subsequent growth of the plantation have been published for teak forest conditions.

A short discussion about the theoretical advantages and disadvantages of this method stresses the point, that we don't know real facts for tropical circumstances : our theoretical discussions are based on researches in temperate climates, but the factors may be wholly different in our teak forests. Any extension of results in other climates to the tropics are, without further research, inadmissable.

In Middle-Java a comparative research into the effect of burning the area before planting teak was executed on an area, stocked with *Leucaena glauca*, 17 years of age. The *Leucaena glauca* was felled and in four blocks it was spread all over the area and burned ; in four other blocks it was carried away and the old stumps killed by digging them up or cutting the shoots. In two other blocks the teak seeds were planted between the rows of old stumps whilst the branches were carried away.

The subsequent growth of the teak on these different plots showed great differences : the burned over areas were better. The crop of rice and maize which was raised in the first year between the teak and *Leucaena* rows was more than 10 per cent. larger on the burned over areas.

After two years' growth the length and thickness of the teak trees on 12 sample plots was measured.

In the first year the length of the teak was averagely 28 cm. or 62 per cent. better, (from the length of the teak on the not burned

blocks), in the second year the difference augmented to 110 cm. or 33 per cent. The diameter at breast height was in the second year 0·8 cm. or 23 per cent. better on the burned over areas.

The cause of these big differences is sought in the manuring value of the plant ash. Roughly reckoned, about 90,000 kg. of *Leucaena* dry matter was burned per ha. which gives a manure of about 1,440 kg. ash with a high percentage of potassium and phosphor.

(*Tectona* XXV, 1932, pp. 71–95.)

Mr. H. G. CHAMPION ON THE EDITORIAL STAFF OF THE ENTOMOLOGIST'S MONTHLY MAGAZINE.

As the name of Champion has so long and so intimately been associated with the *Entomologist's Monthly Magazine* we feel sure that our readers will accord a hearty and unanimous welcome, as a new member of our editorial staff, to the eldest son of our late greatly esteemed colleague. Mr. H. G. Champion, M.A., F.E.S., has followed closely in his father's footsteps in our Science, and has acquired a high reputation as an accurate and observant Entomologist both at home and in India, in which latter country we may be certain that the interests of our Magazine will be well served by him.—(*Entomologist's Monthly Magazine, Vol. LXVIII, January,* 1932).

SCIENCE AND INDUSTRY.

Under the chairmanship of Mr. Herbert G. Sharp, Major J. R. Cosgrove, D.S.O., M.C., of the Forest Products Research Laboratory, Princes Risborough, Bucks., delivered a most interesting and informative lecture at the headquarters of the Timber Trade Federation, on Wednesday evening, under the auspices of the Timber Trade Technical Education Committee, his subject being "The Application of Forest Products Research to Industry." The lecture was illustrated by lantern slides and specimens.

In the course of his address Major Cosgrove said that, briefly described, forest products research is the study of problems concerning the efficient utilisation of timber and the application of the knowledge so gained for the benefit of all concerned. Its main principles refer to the collection and distribution of available knowledge, seeking new information, help to industry in the application of knowledge: and to the reduction of waste—a matter of importance alike in every stage from the standing forest to the ultimate use. He proceeded:

A word should be said about the user of timber. By this term is meant anyone who requires to trade in or use wood or timber in any form, such as the woodland or forest owner who has timber to sell and seeks information as to how the timber should be prepared for use, whether by following a certain method of procedure it may be more suitable than it would otherwise be, and hence effect a sale or a better return; or the merchant who finds deterioration is likely to occur in stock from fungal and insect attack; or the manufacturer who is puzzled by splitting or shrinkage in what is believed to be well conditioned material; or the engineer about to design a structure to carry certain loads or to withstand the ravages of the white ant or the marine borer; or, again, the architect or builder who is grappling with problems of decoration and utility side by side on behalf of his client, seeking tight joints, flat surfaces or freedom from the danger of dry rot among the manifold other questions incidental to the art of building. The Laboratory at Princes Risborough has been set up primarily to assist and serve the timber using industries of Great Britain.

Perhaps the most obvious application of the study of wood structure is identification of timber. Persons of long experience in various branches of the timber trade are able to identify timbers almost instinctively from their general appearance, and there is no gainsaying the uncanny knowledge of timber which may be acquired by constant familiarity, but the wisest and most experienced practical man will be the first to admit that this method of identification is strictly limited as regards the number of different woods which any one man can

recognise at sight. The external appearance of wood may be considerably altered by natural or artificial means, but so long as the wood remains wood, in the ordinary sense of the word, its internal structure remains essentially the same, and it has been found that, as a general rule, the most reliable method of identification is the examination of the structure with the aid of a lens or compound microscope. Every species of wood has its characteristic structure which enables it to be assigned to its appropriate botanical group or family.

Then, given a knowledge of the mechanical properties of a timber it should be possible to foretell the necessary modifications to be made in feed speed, cutter speed, angle of cut, etc., so that woodworking machinery may be adapted to deal with the different mechanical properties. This would apply, for example, in the employment of new or lesser known woods; or those which cannot always be dealt with satisfactorily by existing machinery. The investigation of the theory of cutting tools falls within the scope of the Section of Timber Physics at Princes Risborough.

For the large majority of purposes timber requires to be seasoned, but, as everyone connected with the timber trade knows, the degree of seasoning or drying required often varies for specific purposes. The most important requirement for timber when made up for some definite purpose is that it shall be stable under its conditions of use, by which is meant that it shall not shrink or swell to any appreciable extent. Another reason for seasoning timber is that its strength is increased, and still another that in order to take preservatives it has to be partially seasoned.

Timber in the growing tree may contain as much as four times its own weight in moisture, or as little as one-third. British hardwoods, such as oak and beech, contain about 80 to 90 per cent. moisture when green, whereas the pines and firs may contain about 30 per cent. in the heartwood and up to and over 200 per cent. in the sapwood. For nearly all purposes the bulk of this moisture must be removed, only about 8 to 16 per cent. being left behind. The removal of moisture would present very little difficulty but for the fact that after a certain

stage is reached it is accompanied by shrinkage of the wood substance. The stage at which shrinkage begins is when all the free moisture in the wood cells has been withdrawn and evaporation begins to take place from the wood substance itself. This stage in the drying is known as the fibre saturation point, and occurs at about 25 to 30 per cent. moisture content in the majority of timbers.

Shrinkage takes place in three directions: along the annual rings or tangentially, at right angles to the rings or radially and along the axis of the tree or longitudinally. Were the shrinkage in these three directions the same, and if it was possible to dry all parts of a piece of timber at the same rate and simultaneously, no trouble would be experienced. Unfortunately, the shrinkage along the rings is always greater than at right angles to them, while the longitudinal is very much smaller and can be nearly always neglected.

The customary method of specifying that timber shall have been held for a certain length of time in stick has no accurate meaning so far as percentage moisture-content is concerned, for it does not necessarily follow that, even though in pile for a long period, the timber will remain at the lowest moisture content obtainable by air-seasoning. It is unfair to accuse a merchant of supplying unseasoned timber when the joinery in a centrally heated room shrinks. The moisture-content of yard seasoned timber lies in this country at somewhere between 15 and 25 per cent., according to the time of year. Inch boards of some species may, indeed, fluctuate between these values during one year, when in stick over a hot summer and wet winter.

Taking the average to be 20 per cent., the moisture-content of the joinery for a dwelling house will require to be considerably below this figure in order to be in equilibrium with the average condition of the indoor atmosphere and allow the shrinkage and swelling that would take place respectively in summer and winter to be reduced to the minimum. This means that after air-seasoning a further conditioning treatment is necessary, either in a store in which the air is warmed so as to give the lower moisture-content desired or in a kiln, or, instead of air-seasoning, it may be kiln-dried in certain cases from the green. The

only accurate and safe means of specifying the state of seasoning is by naming the moisture-content. The specifications recommended by the laboratory are as follows :

Timber for		Moisture-content not to exceed	
General carpenters' work	..	25 per cent.	
High class carpenters' work	..	20 ,, ,,	
General joinery work	..	15 ,, ,,	
Best joinery, block and strip flooring, panelling and decorative work.		9-12 ,, ,,	for centrally heated rooms and buildings :
		10-14 ,, ,,	for rooms and buildings not centrally heated.

Although it is not every timber that can be kiln-dried satisfactorily, at least in the thicker sizes, kiln-drying from the green, or a preliminary air-drying followed by kiln-drying, is not only practical politics for a great many timbers, but in many cases will succeed with refractory timbers that season badly in the yard. The dislike of kiln-drying has been largely brought about by lack of understanding of the process —by insufficient control of the conditions in the kiln, too high temperatures and too low humidities, which lead to too quick drying and the like. All timbers do not respond to the same treatment; moreover it is necessary to watch the timber during the run and adjust the conditions and speed of drying accordingly. Troubles may be due in some cases to faulty design of kiln, but faulty operation is more often responsible. Kiln-drying is a technical process which requires, for successful results, a thorough understanding of the principles involved and skill in applying them. The operation should not be entrusted to to untrained, unskilled men. In this connection, the Laboratory offers facilities for instruction.

For testing the efficiency of preservatives intended for use in houses or mines against dry rot fungi, a special room has been built at Princes Risborough, in which the conditions existing in a damp coal mine or cellar have been reconstructed ; the floor is kept covered with

water and the air is warm and damp ; treated and control specimens are placed upon the shelves and an infected piece of wood is nailed to each and the results noted. It has been found that decay so slight as to be almost imperceptible to the naked eye may seriously reduce the strength of timber and that the rate of loss of strength is extremely rapid when conditions are favourable for fungus growth. Small test pieces after 10 weeks' exposure to fungus had only 20 per cent. of their original strength remaining. The specimens were analysed chemically after being tested for strength and the results showed that the loss in strength of the timber was due chiefly to the chemical changes brought about by the fungus, rather than to the physical breaking down of the wood by means of the tiny threads of fungus which penetrate the fibres.

There seems to exist an impression that timber is more easily creosoted in the green condition. This is certainly not so, if only for the reason that the space occupied by the water is required for the creosote. To secure satisfactory results, prior seasoning to a moisture-content of about 20 per cent. is necessary in all processes, whether brush treatment, open tank or pressure, with the one exception of the Boulton process. In the Boulton process the seasoning is done by boiling the green timber in creosote under vacuum, a process which may, however, lower the mechanical values of the timber. Depth of penetration should be as great as possible, and in this connection there is an actual advantage if the timber contains much sapwood. The sapwood readily absorbs creosote, whereas the heartwood, even of easily-treated timbers, is not so readily penetrable. In some timbers, such as larch and Douglas fir, which are difficult to treat, aid is sought in the shape of a process known as "incising."

WORKING AND FINISHING QUALITIES OF WOOD.

Woodworking is an important factor in utilisation, controlling as it does, not only the economy of the operation in time as well as material, but the uses to which a particular wood may be put. Further, well-set-up machines will not only require less frequent overhaul, but will perhaps save, or at least reduce, a subsequent operation, such

as sanding, and will occasion less depreciation of the machines themselves. The behaviour of wood in machining has received but scant attention until recent years, as research has been chiefly directed to determine the other qualities of wood --its anatomical structure, weight, durability, strength and seasoning properties. Investigations of the working qualities of wood fall into two categories:

(1) Determination of the best type of machine and tools necessary for working individual species of timber.

(2) Determination of the behaviour of the wood machined with the most suitable tools, as indicated by (1).

One of the chief factors in this work is the influence of the cutting angle of tools on the finish produced and on the energy consumption of the machine. It is not possible in standard planing machines to vary this angle other than by front honing the cutters, with its corresponding disadvantage of increasing the sharpness angle. With increase of the latter, less sharpening by honing is possible and more frequent re-grinding is necessary. Accordingly, an attachment for planing and moulding machines has been evolved at the Laboratory which may provide positive variation in the cutting angle. This device has been patented, and it is hoped to incorporate it in a standard machine at an early date for experimental purposes on an extended scale in order to test whether it will have universal application.

While the work of the Laboratory is mainly of an investigational character, the application of the results obtained to everyday practice is always borne in mind and is always receiving attention. This work is supplemented by special utilisation activities designed to serve as the main contact for general purposes between the Laboratory and the industry. Every effort is made by the Laboratory as a whole to become acquainted with the wood using and woodworking industries, so that friendly relations are established and first hand impressions obtained of the difficulties with which the industries are faced.—(*Timber Trades Journal, 23rd January* 1932).

THE PRESERVATION OF WOOD.

BY G. GUNN.

Protoplasm consists of living cells which build up the structure of plants and animals and, in the process of fabrication, proteins, or albumens, are produced in the circulatory systems of both. When an animal or a plant dies enzymes come into action and separate the albumens from the other matter in the blood in the case of animals, or in the sap in the case of plants. This is the first stage of decay. Trees contain from 0·69 to 2 per cent. of albumen, the ultimate composition of which is, roughly carbon 54 per cent., hydrogen 7 per cent., nitrogen 16 per cent., sulphur 1 per cent. and oxygen 22 per cent. The point to be noted is that albumen contains nitrogen and that it is the only constituent in the composition of a tree which does. It supplies food energy to outside organisms which may attack the timber, and although small in quantity must be drastically dealt with in wood preserving.

Wood consists of cellulose, lignin, gums, resin, proteins, water and ash, a rough percentage composition being as follows :—

	Per cent.
Cellulose ($C_6 H_{10} O_5$)n	45—63
Lignin	21—39
Proteins (Albumens)	0·69—2
Resins	1·14—1·37
Water of condition	12—13
Ash	0·3—0·7

Cellulose, which constitutes the physical basis of plant life, is also the most resistant to chemical action ; therefore the use of any wood preservative strong enough to injure it would destroy the timber. Lignin, on the other hand, is comparatively easily acted on by chemicals especially by oxidising agents—for example, permanganate of potash. Resins are soluble in carbolic acid ; therefore the tar acids, or phenols and cresols, contained in creosote will dissolve them out. Albumens combine with the salts of the heavy metals, forming albumenates. The following salts which are used in wood preserving are

given in accordance with their toxicity and stability with albumen: Mercuric chloride, copper chromate, copper sulphate and zinc chloride. Strong carbolic acid also combines with albumen, but it can be dissociated by frequent washing with water.

Water of condition is so tenaciously held by wood that it will not part with any to fungi or other hydrolising organisms which require it; therefore well seasoned wood offers good resistance to the attacks of these organisms. The term secondary decay is here used to indicate that sound, healthy, well seasoned wood has been attacked by an outside organism, *e.g.*, fungi, bacteria of the aerobic and anaerobic-varieties, or by boring insects – the death watch beetle, termites (white ants) and finally by the marine borers (teredo, or ship-worm, and limnoria fungi). The more common of the virulent wood hydrolising fungi are: *Fomes annosus*, the lenzites group, polyphorous group, *Coniophora cerebella*, *Merulius lachrymans*. The last-named is very common in this country and does immense damage. Fungi seldom germinate and grow on well-seasoned wood in well-ventilated positions, but for all that such wood may be attacked by fungus growing at a distance. All fungi require moisture, still air, nitrogen in a suitable form, slight alkalinity, *e.g.*, old lime plaster, humus and decayed wood (old wood chips). The plant then grows and forces its way through brick walls until it comes to wood, when the hyphæ attack it by secreting an enzyme which dissolves it. The usual places where food media are found are cellar floors, the soil, debris underneath hearth stones and in roof gutters.

Aerobic bacilli require plenty of moisture, air and nitrogen. Wood is quickly destroyed in wet places. The anaerobic bacilli act under water and therefore require no air, but they require nitrogen. This type is chiefly to be found in the muddy beds of ponds or the mud of sluggish rivers.

The two commonest insects are the furniture and the death-watch beetle, which attack old dry wood and reduce it to dust. The termite is found in tropical and sub-tropical countries, where it does immense damage. The marine borers are the limnoria and the teredo, both

of which are extremely destructive to piling in tropical and subtropical waters and are also quite common in British waters. The limnoria attacks wood from the outside, while the teredo does most damage inside, the trouble seldom being discovered until the wood has been completely destroyed.

The first means of preserving wood is proper seasoning and, if well done by any of the recognised methods, will give wood good immunity from the attacks of fungi and wood hydrolising bacteria ; but where wood is in close contact with the soil, *e.g.*, railway sleepers, fencing, telegraph poles and piling, it is necessary to treat it with a preservative.

The preservatives may be divided into two main classes, oils and salts. In ancient times essential oils, such as oil of cedar wood were used. The wood was bored, the oil poured in and the holes then plugged up ; but from the years of the Roman Empire until the advent of railways—1825—there was little progress in the methods of wood preserving. In the decade from 1830 to 1840 most of the notable inventions were made, both in oil and salt treatments. Kyan introduced mercuric chloride in 1832 : Margary, sulphate of copper, 1837 ; Sir William Burnett, chloride of zinc, 1838 ; and lastly, J. Bethell patented methods of pressing into wood creosotes and saline solutions. This was the most outstanding of the processes. The Bethell method of forcing creosote into wood after it had been first subjected to a vacuum to empty the cells of air as far as possible is still in use to-day, although there are a number of modifications of it. Creosote is the chief oil preservative now used for outdoor work. Creosote really means the distillate from wood tar, but the term is used in a generic sense as comprising the distillates from coal-tar, blast furnace tar, shale oil and water gas tars.

METHODS OF APPLICATION.

Brushing (non-pressure) : Apply hot creosote to dry timber by means of a brush ; two coats at 24 hours apart. Dipping : Submerge wood in hot creosote 5-15 minutes ; (1) wood heated in oil at 200 degs. Fahr. for one or more hours ; (2) it is then transferred to a cool tank, or allowed to remain until cold.

Bethell (full-cell) : Vacuum 24-25in., for one or more hours, then draw in oil and press to 100-180lb. per sq. in. retention ; poles and structural timber, 6-12lb. per cub. ft. ; paving blocks, 12-20lb. per cub. ft. ; salt water piles 16-24lb. per cub. ft.

Boulton (full-cell) : For quick seasoning of wet timber which has to be treated with a preservative, start with oil heated to 212 or 215 degs. Fahr., apply vacuum until the temperature is reduced to 180 degs. Fahr. ; pressure applied until 12-14lb. per cub. ft is retained for sea-water piles. Boiling temperature 180 degs. Fahr., vacuum 18 to 21in. ; time, 9-27 hours ; water extracted per cub. ft. 3-10 lbs. Pressure period : Temp. 190 degs. Fahr ; pressure 200lb. per sq. in. ; vacuum 22-24in. ; time, 4-5 hours. Final vacuum, 22-24in. ; time, 45 min. ; retention, 6-14lb. per cub. ft.

Lowry (empty cell) : The timber is heated without vacuum at a temperature of not over 200 degs. Fahr. until the required quantity of water comes over, then apply pressure to refusal. Drain oil and apply quick vacuum. Retention, 6-8lb. per cub. ft.

Rueping (empty-cell process) ; (1) Press air into wood, 6-80lb. per sq. in. ; (2) admit oil under air pressure, then press to 150-200lb. per sq. in. ; drain off oil and apply quick vacuum. Retention 4-6lb. per cub. ft.—(Timber Trades Journal. 2nd January 1932).

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LESSONS FROM THE BRITISH INDUSTRIES FAIR.

The furniture exhibits at the British Industries Fair have attracted wide publicity at home, and have emphasised the great potential value of our empire timbers. The Fair in fact marks a further stage in applying the slogan of "Buy British" to our empire forest produce. The use of Indian woods has been well advertised and the interior decorations of India House, Aldwych, is now almost one of the sights of London, so widely has it been noticed in the illustrated and technical journals throughout Europe. It is to be hoped that economies in the Trade Commissioner's grant will not put a stop to such useful propaganda, for much has yet to be done before an established market can be found for even the best of our Indian woods.

The market depression at home has had the effect of forcing the furnishing trade to develop along the lines of mass production, using the less expensive woods for "lamin" and batten board cores faced with the more expensive timbers as veneer facings: the opportunities for work in solid material such as has been done at India House are relatively few and far between. There is very keen competition, both in the supply of hardwoods from Central Europe, America, Japan, West Africa and Australia, much of which is eventually sliced for veneer, and in the importation of ready-made plywood and veneer from various other countries.

It therefore seems that, apart from the luxury trade in a few of our best timbers, we cannot expect any rapid development in marketing Indian timbers in Europe. On the other hand the Indian markets for

our sleeper and heavy structural timbers are not so good as they used to be. The best chance of improving our timber sales is, therefore, by developing and encouraging the uses of small timber such as furniture, panelling, parquet flooring, plywood, veneering, carving and turnery. There is an enormous potential market for all these things in the towns, where improving housing conditions and a rising standard of living amongst the middle-class Indian house-holders is opening up fresh possibilities for local timber. We have seen that by official encouragement an annual enterprise such as the British Industries Fair can be built up in a very short time and is of immense value in assisting the improvement of industry. Now apply the lesson to Indian conditions :—we have the raw material, including some of the finest timbers in the world ; we have the skill, for the furniture exhibits in the Forest Economist's branch at Dehra Dun are of superb workmanship ; we have a great field for developing a better class of timber requirements all over India, what we need now is some form of propaganda or travelling exhibition in each district which will show the people what can be accomplished by making better use of the timbers which grow at their doors.

Any educational effort of this sort should be directed towards getting the Indian middle-class house-holder to use better timber in his house and a better quality of furniture. The average Indian household does not of course use as much furniture as a European one does, but there is tremendous scope for improving upon the few articles in regular use. Welfare work is only starting, and there is certainly much work to be done in teaching and helping the house-holders of India to improve their standards of living, and to make a better basic use of the newly distributed wealth of which gramophones, alarm clocks, and joyriding in motor buses are the outward and disturbing signs. By helping the local welfare organisations and by showing the leading spirits the value and beauty of good timber work and furniture in their homes, we as a department would have the double satisfaction of developing our local forest resources and of contributing some really constructive thinking to the new India which is forming around us.

The time is now past when we could flatter ourselves that our future as a service was independent of trade. If we are to keep abreast of modern developments we have got to shed that superiority complex about the difference between Government service and trade, which is one of the worst features of both European and Indian society in this country. Unfortunately we have not got the Prince of Wales here to act as a figurehead in popularising trade campaigns, but much might be done from small beginnings if the Divisional Forest Officers throughout the country took a more active interest in the ultimate fate of the timber which is removed from their forests. We do not want to lose sight of the fact that we are *conservators* of forests, but if we are to get the financial support without which the department must atrophy, it behoves each of us to take a more practical interest in creating and catering for a public interest in our Indian timbers.

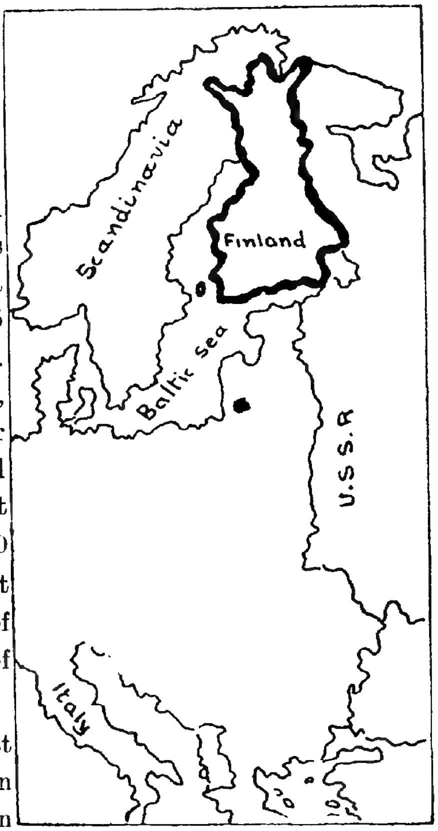
As a practical suggestion, we would recommend that more use might be made of the Wood-Working Section of the Forest Research Institute by getting advice as to how supplies of potentially useful timber might be utilised to better advantage than they are in the usual local furniture articles. Improved samples made by skilled carpenters and showing each timber species to its best advantage could then be shown to traders and dealers at each local timber sale, sent in as an exhibit to any local agricultural or industrial show, or lent out to reliable furniture dealers to put in their show-rooms.

R. M. G.

FORESTS OF FINLAND.

M. D. CHATURVEDI, B. Sc. (OXON.), I.F.S.

1. AREA AND POPULATION.



1. The total area of Finland is about 150,000 square miles, which is about 1½ times the area of the United Provinces. Of this area, 11·5 per cent. is covered by a net-work of lakes and rivers, a special feature of the northernmost regions of Europe. Of the total *land* area of about 132,630 square miles, 73·5 per cent. is forest land, 14·7 per cent. is waste land including swamps, etc., and the remainder 11·8 per cent. is occupied by cultivation and public grounds, etc. The forest area, which amounts to 97,500 square miles approximately, is not all productive. About one-fourth of this comprises swamps, forests of poor growth and inferior woods.

2. Finland is about the most thinly populated country in Europe. A very large proportion of its population, which is about 3½ millions, is confined to the comparatively warmer regions in the south bordering the Baltic. The population progressively decreases from 46 to a square mile in the south to about six in the comparatively inhospitable northern regions in the arctic zone. The mean density of population is about 27 to a square mile. The forest area per head of population amounts to 18·3 acres which is considerably more than in any other country in Europe; the average figure for the whole of Europe being about two acres per head of population.

Finnish Landscape at Valkeala.

Draining the Swamps at Parkano.

2. Climate.

3. Finland extends from the Arctic Ocean in the north (70° N. Lat.) to the Gulf of Finland in the south (60° N. Lat.) and measures about 700 miles north to south. The climate of Finland, notably of the northern regions, may be described as nine months winter and three months summer. Comparatively lower temperatures prevail in the north, the land of the midnight sun, than in the south. The mean temperatures vary from −15° C to +14° C in the north and −3° to—6°C and +16° C in the south for January and July respectively. The total precipitation amounts to 20 to 28 inches per annum. The ground is covered by snow for seven months in the year in the north, five to six months in the middle, and about 3 months in the south of Finland.

3. Ownership.

4. According to the results of the General Forest Survey the ownership of the forests of Finland is distributed as under :—

	Per cent.
Private forests	51·0
State forests	38·9
Joint stock companies	7·5
State controlled forests	0·9
Ecclesiastical forests	1·0
Municipal and rural communes ..	0·7

4. Geological Formation.

5. The general topography of the country is fairly flat and uniform. The country is cut up by numerous lakes and rivers, a feature characteristic of the northernmost regions of Europe. Superficial glacial deposits cover the ground all over, giving the country a slightly undulating appearance ; the highest peak seldom rising above 3,000 feet. The rock formation is usually poor in mineral deposits. During the Ice Age the whole country was heavily glaciated leaving an almost flat mass of granite. The encroachment of the sea in the subsequent period and its ultimate disappearance has left sea sand here and there ; while the receding glaciers have caused morain deposits which occur freely in the soil. The comparative general absence of lime from the

soil has led to an overwhelmingly ericaceous vegetation. Owing to the flat nature of the country and consequent sluggish drainage further impeded by rank forest vegetation, peat bogs and swamps abound all over the country, notably in the northern and eastern parts. A little over a third of the total land area of Finland (35·7 per cent.) is swampy. About 90 per cent. of these swamps were once forest lands, and have been converted into peat bogs, owing to poor drainage. These bogs vary considerably in quality. About 4/5ths of the bogs support some kind of vegetation, poor, rich or indifferent forest crops; but the remaining 1/5th is quite bare. The swamps have been classified under :—

	Per cent.
Spruce swamps	19·7
Pine swamps	53·8
Sphagnum and brown moss bogs ..	21·1
Meadows (swamps)	4·4
Fields converted from swamps	1·0

5. Growing Stock.

6. Finland pre-eminently belongs to the North European pine region, the Scots pine (*Pinus sylvestris*) being the characteristic tree. The whole country is a large continuous forest interrupted only here and there by a net-work of lakes and rivers, peat bogs and agricultural land (11·8 per cent.) which is largely confined to the milder southern regions. The forest flora of Finland is exceedingly simple and is chiefly composed of coniferous species, pine and spruce (*Picea excelsa*) with a little admixture of broad-leaf species notably in the southern regions. The distribution of various species over the total forest area is as under :—

	Per cent.
Mainly pine	55·2
Mainly spruce	24·8
Conifers (total)	80·0
Mainly birch (*Betula odorata*, *B. verrucosa*) ..	16·9
Mainly alder (*Alnus incana*, *A. glutinosa*) ..	1·5
Mainly aspen (*Populus tremula*) ..	0·2
Denuded area	1·4
Broad leaf (total)	20

The northern regions are conspicuously free of alder and aspen which are exclusively confined to the warmer south. The birch is

Mature Pine Forest at Mantta.

Birch Forest (40 years old) at Heinavesi.

more or less evenly distributed, but occurs rather freely in the north. Of these forests 50·4 per cent. are pure* and consist of the following species :—

	Per cent.
Pine	34·3
Spruce	8·6
Birch	7·0
Alder	0·5

The mixed forests are distributed as :—

Pine and spruce	12·2
Pine and birch	12·4
Spruce and birch	11·2
Pine, spruce and birch	6·7
Pine mingled with alder	3·7
,, ,, aspen	2·0

7. The rate of growth in the northern regions is about half of that obtaining in the milder south. In the south, while the mid-age woods preponderate, both the young and the exploitable age classes are scarce. In the north, the mature and over mature stock is abnormally high, while there is a great deficiency of young age classes.

8. According to the General Forest Survey the total growing stock of Finland is 57,200 million cubic feet (solid measure including bark). The annual increment, excluding bark, is 1,568 million cubic feet. The growing stock is distributed as under :—

Ruling Species.	Per cent. of Forest Area.	Growing Stock. Millions cubic metres.	Growing Stock. Per cent.	Annual increment. Millions cubic metres.	Annual increment. Per cent.
Pine ..	55·2	777·3	48·0	19·71	44·4
Spruce ..	24·8	480·5	29·6	12·26	27·6
Birch ..	16·9	318·5	19·7	10·30	23·2
Alder ..	1·5	21·0	1·3	1·42	3·2
Aspen ..	0·2	22·7	1·4	0·71	1·6
Open spaces ..	1·4	..	..	..	...
Total ..	100·0	1,620·0 or 57,200 c.ft.	100·0	44·40 or 1,568 c.ft.	100·0

* Where other species except the ruling species amount to less than 10 per cent.

The quantity of growing stock per head of population is 16,800 cubic feet. The mean volume per acre of the Finnish forests is 918 cubic feet. The mean current annual volume increment per acre is 25·2 cubic feet.

6. THE GENERAL FOREST SURVEY.

9. The General Forest Survey of Finland was initiated by Dr. Lakari in 1921. The survey was effected by means of the line method. Thirty-nine survey lines 26 kilometres apart from one another (and five over Oland islands) were drawn over Finland running north-east to south-west and the data regarding soil, forests, growing stock etc., was recorded. Sample plots were measured at an interval of two kilometres, and figures regarding volume, increment, age, quality, etc., of the crops were collected. The reliability of the data so collected was also carefully tested. The survey was finished in 1924, and has been described in detail by Professor Ilvessalo. (1).

7. FOREST TYPES.

10. Professor Cajander (2) has distinguished definite forest types based on an ecological study of the ground vegetation. The site classes are named after the plants which are invariably found associated with them. In a cold country like Finland, where climatic conditions render the physiological activities of the vegetable kingdom slow, it is not surprising to find some plants becoming a concomitant feature of certain types of localities. In temperate zones also, where the growth is generally faster and the alternation of species takes place comparatively quickly, plants as indicators of soil are not unknown. In tropical regions, however, the incident light plays such an important rôle in determining the quantitative and qualitative nature of the ground vegetation, that weeds invariably give an indication more of the condition of the upper canopy than of the type of the soil. Even under Finnish conditions the forest types are not absolutely rigid. It has been claimed that the "type-indicator" plants are an infallible guide of the quality of a locality, even though it may have no trees, or so many trees as to suppress the indicators themselves. Prof. Cajander believes that in Finland site classes are quite distinct having an entity of their own. While it is true that fire, excessive grazing,

removal of litter and an interruption in the natural drainage may considerably change the type of locality, the change, however, can be measured and a definite relation established between the original type and the deteriorated type. The removal of such adverse factors leads to a reversion to the original type. In Finland, forest types, and not quality classes based on heights of stands, are used in yield tables. All stock mapping is done by forest types. The General Forest Survey was also carried out according to forest types. The forest type constitutes the main unit of all silvicultural operations like regeneration fellings, extent of thinnings, etc.

8. Administration.

11. It was not till 1851 that a temporary forest service was created by the Russian Imperial Government to administer the State Forests of Finland. Shortly afterwards (1859) this temporary department was made permanent and consisted of a central board, chief forest supervisors, supervisors, and forest guards. Except for a few minor modifications in the constitution of the Central Board of Forestry which was subordinated to the Ministry of Agriculture in 1863, and reorganised on a collegial basis in 1908, the administration in its essential features continued to be along the same lines as laid down in 1858. In 1921, after the Peace Treaty of Tartu which secured independence for Finland, Professor Cajander (3), the Director-General of Forests, completely reorganised the forest administration. The forests are, as before, under the Minister of Agriculture, who also controls fisheries, colonisation and settlement, shooting and agriculture. There are two separate sections. The State forest section which has four sub-sections; Working Plans, Land and Settlement, Engineering and Business; and the Private forest section consisting of Management Divisions and Supervision. The heads of sub-sections along with the Director-General and his Assistant constitute the Board of Forestry, which is organised on a collegial basis.

12. The Assistant Director controls the State forests which are divided for this purpose into four circles and each circle is further subdivided into two or three sub-circles. Each circle has a "directorate" consisting of a head and as many inspectors as there are sub-circles. On

an average each circle has been divided into eight *reviers* (divisions). There are at present four circles, 10 sub-circles and 84 *reviers*, which consist of 113 ranges and 827 beats. The average size of a *revier* is 400,000 acres quite two-third of which is usually forest land. The business division controls the accounts of sales. The Board of Forestry also consists of Secretarial, Accounts, and Statistical bureaus which are also represented in the circle offices.

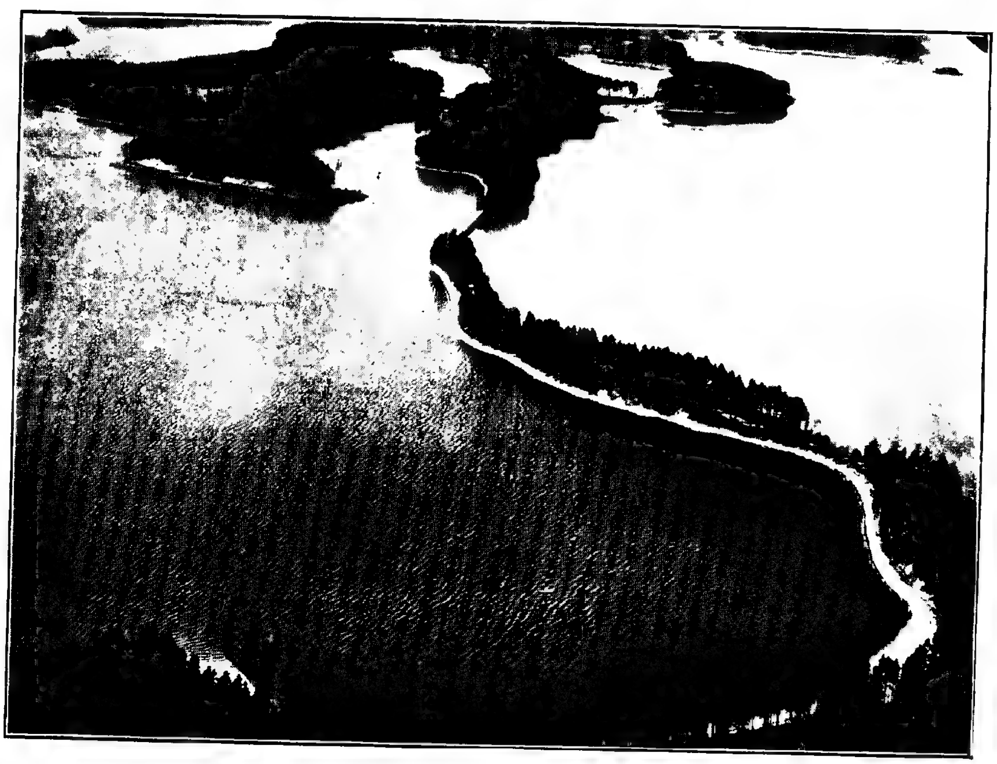
13. The Private forests section consists of Management Divisions, one of which looks after the ecclesiastical forests. Another division namely the "Supervision" controls (*a*) the Sawmill school, (*b*) the Ranger schools and (*c*) the Provincial Forest Commitees which are eight in number (and one in Oland islands). The Provincial Committees exercise control over privately owned forests belonging largely to farmers. These committees were constituted in accordance with the ordinance of 1917 and consist of usually two members selected by the Board of Agriculture from members proposed by Provincial Agricultural societies and one member from the Private Forestry Section. These committees engage provincial forest inspectors, rangers and foresters at the instance of the Board of Forestry for the control of private forests. (4) Recently an association has been formed for the management of the private forests. This association is known as the *Tapio.** It seeks to replace the present system of selection of members on the Provincial Committees by election. Forest owners have also formed themselves recently into co-operative societies for purposes of sale of timber and at places sometimes there are co operative *reviers* (divisions). Each division is composed of small holdings belonging to farmers and is managed in their interest.

9. WORKING PLAN ORGANISATION.

14. The Chief of the Working Plan Section of the Board of Forestry Dr. Lakari (5) has two assistants, four working plans officers, 16 surveyors and survey rangers. Each circle has a working plan office,

*The *Tapio* (a forest god) was reorganised in 1928. On this association are represented 18 conservation boards, 19 agricultural societies, 380 other small farmers' societies, 30 other associations and 20 forest societies of farmers and 324 personal members. It has an Administrative Board of 12 members which is elected at an annual meeting. This Board elects a Board of Directors who appoint an executive staff of trained foresters.

Spruce Forest in Winter. N. Finland



Experimental Station at Punkaharju.

there being four such offices and to each circle office a working plans officer is attached. About eight to ten working plans are revised every year. The revision takes place every 10 years. A sustained yield is not aimed at for each *revier* (division) but for each sub-circle and circle, The field work consists of stock mapping by species and age classes and also according to Cajander's types. An inventory is made giving volume per hectare, age, density, mean height and percentage of different species. The yield is calculated largely on the area basis and is checked by increment. The actual cutting scheme is mapped in various colours. The extraction of the annual yield depends on silvicultural considerations and the condition of the market and is fixed for a period of 10 years. The shelterwood method is employed as a rule and natural regeneration is easy except in the north where rigorous climatic conditions prevail.

10. Forest Education.

15. In the University of Helsinki there is a Faculty of Forests and Agriculture (since 1908). A *forstmeister* (D.F.O.) takes three and a half years to complete his course. There are also degrees of Master and Doctor of Forestry conferred by the University. There are four schools for forest rangers with a two years' course. There is also a saw-mill school (*vide* para. 13). The University has a demonstration forest area of its own under a forest officer directly under the State forest section of the Board of Forestry.

11. Forest Research.

16. The importance of forests in the national economy of Finland was emphasized as early as 1747 by P. Kalm and later by P. A. Gadd (1758) professors of economics and chemistry in the University of Turku (Abo). Kalm introduced and experimented on various exotics from North America, and Professor Gadd was later actually the director of plantations. The Tsars established a plantation at Raivola of *Larix sibirica* as early as 1738. This plantation is now 193 years old. In the early forties of the eighteenth century two larch plantations were established by private interests and several other exotics

were tried. The Evo Forest Institute was founded in 1860 and attention was chiefly drawn to the establishment of forest parks in each province and investigations were made on foreign and native species in the forest attached to the Institute. Burning and planting was the usual method resorted to. For lack of students the Evo Institute was closed in 1866 and was not re-opened till 1871 when practical and not scientific instruction was sought to be given to the students. The Forest Institute was amalgamated in the University of Helsinki in 1908. The old Evo Institute produced little of real scientific interest except a few publications like yield tables, the rate of growth tables and descriptions of trees of Finland. The Agricultural Institute at Mustilla carried out some investigations in the eighties dealing with the temperatures prevailing under forest growth and in the open; the significance of thinnings; burning; exotics; detrimental effects of grazing; tar distillation; and heating power of various species. The Board of Forestry also instituted certain silvicultural experiments in the seventies in the State forests. Professor Norrlin's researches in plant geography in the last decades of the nineteenth century were also not without considerable practical significance in the Finnish forestry. (6) Mr. Tigerstedt's investigations on his private estates at Mustilla with exotics also deserve mention. These experiments have been carried out on rigid scientific lines and deal with no less than about 200 species. This work was undertaken in the beginning of the present century and as an example of individual effort is entirely unique in Europe.

17. The creation of the Faculty of Forestry and Agriculture in the University of Helsinki under Professor A. K. Cajander (7) in 1908 gave a much needed impetus to forest research in Finland. The scientific environments which a University secures for research work reacted favourably on forest investigations. A special Scientific Society of Forestry was founded soon afterwards. The Society had to struggle for its existence during the Russion regime and owing to lack of financial support much of its work could not be published. By 1913, the Government had permitted the publication of two volumes of *Acta Forestalia Fennica* from the proceeds of the Langman Endowment

Fund. The proposal for establishing a Forest Research Institute in Finland was shelved by the Government by appointing a committee in 1913 which recommended a temporary Institute and the Great War postponed the foundation of the Institute *sine die*. The year 1917 saw the end of the Russian regime, and the Forest Institute was founded on July 1, 1918, and has been ever since one of the leading Forest Institutes in Europe.

18. The Forest Research Institute at Helsinki has the following sections :—

1. Silviculture.
2. Forest Mensuration and Valuation.
3. Forest Soils.
4. Swamp Science.
5. Forest Economics.
6. Forest Utilization.

For purposes of administration the Institute is nominally under the Board of Forestry. It has a separate entity of its own and *elects* its own director. There are at present 14 experimental stations to which large forests are attached which are managed by trained forest officers under the guidance of the director. The area of these experimental forests varies from 40,000 to 15 acres. During such a short period of existence, the Institute has to its credit various investigations notably on treatment of swamps, experiments on thinnings, planting experiments, and last of all though not least of all the Great National Survey of the Finnish Forests. It has published 10 volumes dealing with 33 investigations.

12. Utilization.

19. The forests of Finland, extensive as they are, provide owing to extraction facilities an extremely important source of timber and allied products for the Continent. The extraction is exceedingly simple. Fellings are largely confined to the cold weather when the logs are transported on sledges to the rivers. There is a remarkable net-work of rivers and lakes occasionally supplemented by canals which keep the cost of transport extremely low. The country is flat

and the gradients the timber has to negotiate are usually mild. The snowfall during winter renders the hauling of trees even under difficult topographical conditions easy. Forests constitute the main source of revenue to the State and form an important national industry. Quite half the industrial population is kept employed in forest industries, and the revenue derived is 46 per cent. of the total revenue of the State.

20. Larger trees of pine and spruce are usually converted into deals and boards, and the smaller stuff, tops of trees and waste products of saw mills are used for paper pulp. Birch is used in plywood industry, and aspen in match factories. There are several saw mills and paper mills. The latter produce largely mechanical pulp for export, and the paper manufactured is for home consumption only. Of the total exports of Finland the forest products amount to 80 per cent. or even more. The export figures of the years 1927 and 1928 taken from Hilden's (8) brochure will illustrate the type of wood products which go abroad.

	In 1927.	In 1928.
Sawn goods, Stds.	1,283,200	1,146,500
Round Timber, m^3	4,368,100	3,876,300
Plywood, tons	57,202	82,882
Spools, ,, ...	5,744	5,559
Paper, ,, ...	223,466	243,807
Chemical pulp, ,, ...	363,572	473,023
Mechanical pulp,, ...	140,424	182,965

England is the best customer of Finland as far as timber is concerned. The mechanical pulp is becoming increasingly popular on the American Continent and finds its way the world over.

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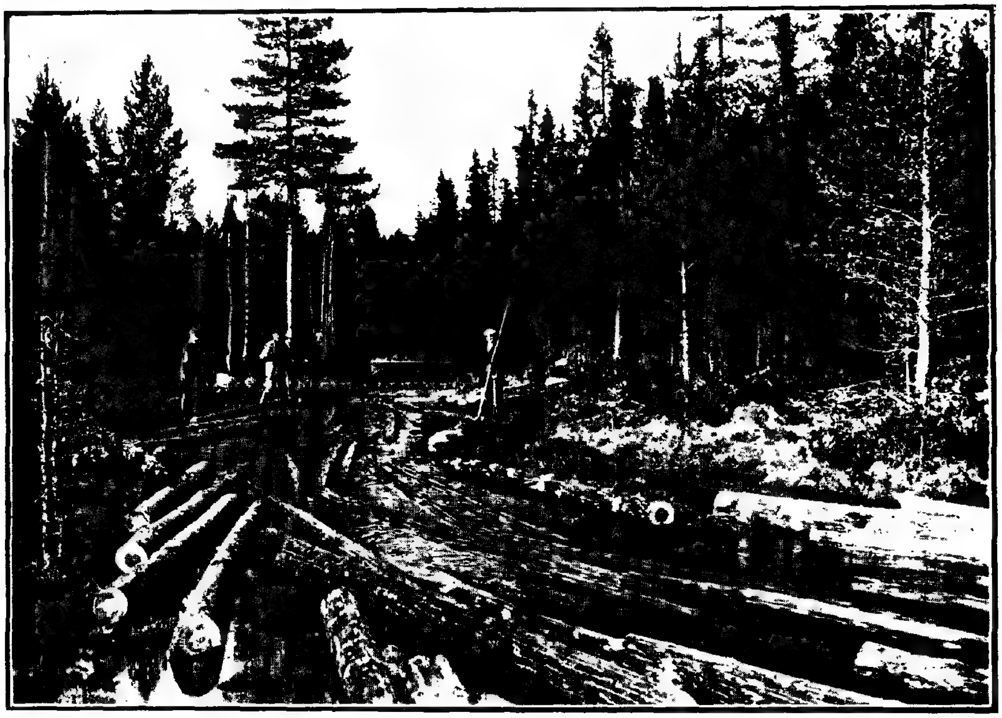
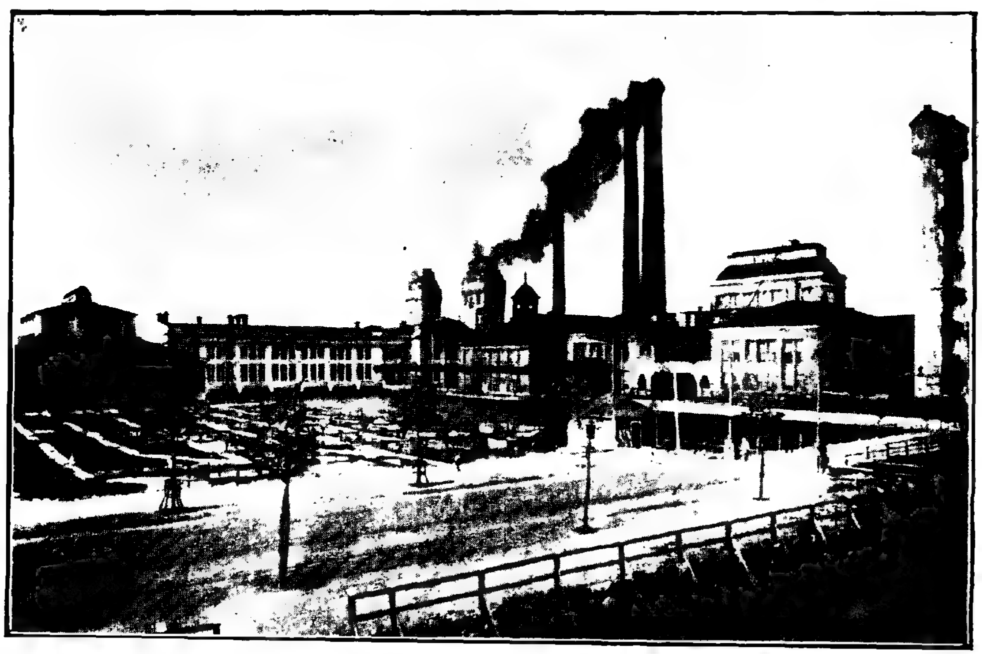


Floating Logs at Multia.



Varkaus Paper and Pulp Mill.

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With grateful acknowledgment of the help given to me by Professors Cajander, Saari and Lakari. To Professor Ilvessalo my special thanks are due for personally conducting me through some of the most interesting forests in Finland and placing at my disposal all available information regarding them. The Institute at Helsinki has supplied the photographs.

[Reference might also have been made to W. E. Hiley's "Forest Industry of Finland," Oxford Forestry Memoirs, No. 8, 1928, in which some of the above information has already been printed.—Hon. Ed.]

A VERY PLEASANT EVENING'S FISHING.

For months we had planned a tour down a famous river, we had overhauled our tackle, got good boats and boatmen who really could row a boat quietly and all augured well for a successful expedition after the mighty mahseer. The river was, however, low and ginclear and not a fish would bite : we could see them lying like logs and lazily moving away as the spoon came near them. Nothing but a charge of dynamite seemed likely to be of any avail. We got very bored. So did Jess. We felt drowsy. So did Jess. Lazily she smelt the bait and then she got a sharp and tenacious treble hook buried in her nose. Quiet no longer, confusion reigned supreme till some very effective surgery freed the hook and a fat black spaniel decided that she hated fishing and its manifest discomforts. At last it rained and the river became like pea-soup. Still the monsters of forty and fifty pounds weight refused to bite, even when the water cleared. So in the evening we took a trout rod with plenty of line, a fine trace and a tiny fly spoon and cast under a cliff at the end of a race in heavy water where some rocks afforded shelter from the current.

The first fish came like a tiger and took out yards and yards of line. Our boatman's calm departed : the fish pulled one way, the boatman another and soon the fish and ourselves were parted by nearly all the line on our reel. Of course we swore—who wouldn't ? but the boatman at last calmed down, the fish became more manageable and we beached the boat and played him from the bank.

At the end of a quarter of an hour we landed a beauty of 10 lbs., all shining bronze in the evening light, not so bad, and life once more was well worth living. Back across the river again letting the boat drift past the same small clifi and we got a 2½ lbs. fish. Next time we did better still with a 1¼ pounder. Next time—but there was no next time as an oaf of a cooly, who had been watching us, stood on the cliff immediately above where the fish lay and off they went. Lower down they were undisturbed and we were soon busy again.

One fishing story is very like another, save that this one happens to be true, so I won't bore you with details. The bag was 10 fish total weight 32 lbs. and all on a trout rod. As good an evening's fishing as one could possibly wish for.

Panjabi.

THE ERADICATION OF PARROTIA JACQUEMONTIANA FROM THE CONIFER FORESTS OF KASHMIR.

BY H. S. JAMWALL, DIVISIONAL FOREST OFFICER, LANGET DIVISION.

While comparing the progress of regeneration work under the shelterwood system the Divisional Forest Officer, Ramban Division, has very ably and elaborately described in the *Indian Forester* for February 1932 a successful method of eradicating *Parrotia* in the Udil Range in his Division. A few months prior to this the writer received a similar note direct from Pt. Dina Nath Kaul, Assistant Conservator of Forests in charge of the above Range. The method evolved, though quite novel to many forest officers in this part of the valley, seems to have found favour in Ramban Division, where the Divisional Forest Officer and his Assistant have more or less standardised it in their regeneration work.

The key to the success of the system lies in the fact that *Parrotia* is burnt standing late in autumn by lighting a very severe fire within a radius of two yards around the collar so that the soil in which the roots are embedded is also effected.

(2) The problem of complete eradication of *Parrotia* is one that is not confined solely to Ramban Division, but is a problem which affects all the conifer forests of Kashmir in particular and those of the Northern Himalaya in general. The first question that arises is this: —" Is it silviculturally and economically desirable to completely exterminate *Parrotia* (*pohu*) from the conifer forests as a whole ? " The curt reply, of course, according to the above note of the Divisional Forest Officer, is that *Parrotia* must be ruthlessly destroyed by burning wherever it occur in the Jammu and Kashmir forests.

(3) In Kashmir, however, *Parrotia* (*pohu*) is the only deciduous species that springs up as an underwood in all the conifer forests of the State. It is, therefore, essential that the silvicultural importance of the shrub should not be lost sight of by those who are working in such forests before they inaugurate any campaign for its destruction on a vast scale both in and outside Kashmir State. An attempt is, therefore, made in this article to weigh up the various factors for and against

the complete eradication of *Parrotia* (*poho*) from the conifer forests. It is hoped that the points discussed will clarify the silvicultural position of this useful shrub which must eventually be the deciding factor for or against its complete eradication from the Kashmir forests.

(4) It must be borne in mind, at the very outset, that, though the economical and silvicultural value of any woody plant differs according to local conditions and a plant which is a weed in one locality may be a most useful adjunct in others, the inherent silvicultural properties of any plant in the forest remain the same and should not necessarily differ from one locality to another, provided it is growing under similar ecological environments. With this idea in view it is advisable that the silvicultural advantages and disadvantages of *Parrotia* be discussed at length in order to obtain a true impression of the intrinsic value of the shrub.

(5) The advantages of *Parrotia*, therefore, may be stated as under :—

(*a*) It is admittedly a good soil improver and is, therefore, a boon in conifer forests where it forms the best medium for the quick decomposition of the accumulated thick and dry humus. Indeed, a good and rich humus is out of the question in these forests unless the leaf-mould is thoroughly decomposed, which latter process is accelerated only by the mixing together of hardwood litter with that of conifers.

(*b*) Undoubtedly the prevailing hardwood species in the under storey of the Kashmir forests is *Parrotia* (*poho*) and if it is ruthlessly eradicated, as in Udil Range, there will be no other species to take its place and the ultimate result will be the complete disappearance of the only hardwood from these forests, a transformation that must certainly be abhorred by all forest officers.

(*c*) In most of the open deodar and pine forests of the valley *Parrotia* plays a useful rôle by serving as a nurse to deodar and pine seedlings growing beneath it. In fact, the popular

notion here is that if you want to find new regeneration in these forests you must look for it under the *pohu* shrubs that have not only nourished it but have also protected it from inroads by predatory animals.

(*d*) It is indeed very useful in forests adjoining cultivation where damage to young seedlings by village cattle is excessive.

(*e*) Where economic conditions are favourable, as in the Lolab Range of the Kashmir Forest Circle, it (*pohu*) may well be exploited as firewood ahead of the major fellings of deodar and pine.

(*f*) The most fundamental point in favour of *Parrotia* that can never be ignored is that in modern forestry all over the world an admixture of 10 to 12 per cent. of hardwood species is deemed absolutely necessary in conifer forests. In fact, the writer has seen with his own eyes 10 per cent. of oak being transplanted along with Scotch pine in the Frankfort forests of Germany, which are under the efficient management of Mr. Carl Phillip, the renowned forest officer of that place.

If, therefore, *Parrotia* is considered such a menacing weed that it must be eradicated forthwith from the Kashmir forests, as is being done in Ramban Division, no broadleaved species will be left to constitute the 10 per cent. admixture of hardwoods considered to be necessary in conifer forests and to play the important rôle of "soil improver" that is so essential in these forests. The writer believes that this factor alone is of such importance that it can refute all arguments in favour of the complete eradication of this shrub.

(*g*) Finally, to quote the Divisional Forest Officer, Ramban Division, *vide* page 81, "it is a good servant but a bad master."

It is, therefore, not only silviculturally but humanly cruel to exterminate a good servant like *Parrotia*, whose only crime is that it has taken control in the locality in question.

The disadvantages of *Parrotia* are few and they may be briefly noted as follows :—

(*i*) The greatest sin of the shrub is that it grows gregariously and, more often than not, takes complete possession of the ground and invariably chokes to death anything growing under its dense shade.

(*ii*) When cut flush with the ground, it coppices very vigorously and forms very dense masses which impede the reproduction of deodar and pine.

(*iii*) Finally, the wood is very hard and consequently cutting back is generally a costly operation.

(6) It is thus clear from the silvicultural advantages and disadvantages of *Parrotia* discussed above, that the latter are eclipsed by the former by considerations that cannot be ignored by those destined to raise and rear trees scientifically under the modern intensive system of forest management. Forest officers in general, and those of Kashmir in particular, will, indeed, think twice before they will ever contemplate embarking on any campaign to eradicate *Parrotia* from deodar forests, as is being done at present in Udil Range. Of course, there is no gainsaying the fact that *Parrotia* grows so densely in certain localities as to make regeneration of any other valuable species absolutely impossible, but the remedy proposed in the note by the Divisional Forest Officer, Ramban, and his Assistant seems worse than the malady itself.

(7) In theory the method evolved for eradication of *poha* is not only simple but is a remarkable feat of ingenuity that reflects great credit on the officers concerned. But for the technique to be applied in actual practice the following points require further elucidation :—

(*a*) Slash piles 1 to 3 feet in height are hardly sufficient to burn the root system of a deep-rooted species like *Parrotia* very severely.

(*b*) A fire is never considered to have been severe unless the ground is thoroughly blackened by it and the soil of the

ash beds has been turned red hot, and for this purpose one would like to have piles 4 to 6 feet, or even more in height, depending on the space available in between the seed bearers. The slogan here is that the severer the fire the better the growth of seedlings in the ash beds and it is, therefore, questionable whether slash piles 1 to 2 feet or even 3 feet in height, will really give fires severe enough to achieve the end in view.

(*c*) It is not clear how the crown of *Parrotia* will transpire vigorously without its leaves in late autumn. If, however, it does not shed its leaves in autumn in Udil, in concord with other hardwood species, it is a fact that yellow, shrivelled leaves, dead as they are at this time, though still adhering to the plant, have lost all vitality and cannot function actively, while the leaf scars covered over by a thin membrane absolutely prevent crown transpiration.

(*d*) The operation is particularly unsuitable in pine forests where inflammable material heaped around *Parrotia* growing to a height of 20 feet may result in a crown fire which will burn the seed-bearers along with the weed.

8. From all that has been stated above it is quite obvious that complete eradication of *Parrotia* from conifer forests as a whole is neither economically desirable nor silviculturally permissible and that it must be handled more carefully and treated more scientifically than has hitherto been the case in some places.

Before concluding this article the writer cannot but put forward a few suggestions of his own as the result of his personal experience of working in the Kashmir forests for the past six or seven years.

The suggestions are as under :—

(*i*) The *Parrotia jacquemontiana* shrub or small tree, should never be eradicated altogether, but must certainly be eliminated to a certain extent where it is a menacing weed in conifer forests.

(*ii*) It should not be burnt standing, but must be cut back at a height of 3 feet, or over, so that it is unable to put forth vigorous shoots. It must be remembered that this method is generally used the world over for similar aggressive species, such as hazel in Europe and scrub oak (*Quercus ilicifolia*) in the Eastern United States.

(*iii*) It is better to cut back the shrub, as stated above, a year or two ahead of the major fellings of deodar and pine as the *Parrotia* will then hardly be able to put forth vigorous shoots under the dense canopy of overwood. Most of the stems cut at this time will very probably die a natural death and this phenomenon has been demonstrated with success in the deodar forests of Langet Division.

(*iv*) The so called grotesque, unkempt appearance of a forest, as described by the Divisional Forest Officer, Ramban, is comparatively immaterial and seems decidedly better than the nasty black appearance of a wooded area after a fire.

(*v*) The question of cost incurred in cutting back *Parrotia* is certainly a factor that cannot be ignored. But experience has shown that the expenditure is not very exorbitant, provided that the work is carried out under the supervision of an intelligent officer not below the grade of 1st Class Ranger.

A WELL-KNOWN DEPREDATOR.

In Mr. Dover's article on the longevity of some Indian animals (*Indian Forester*, February 1932) he says: "Records of extreme longevity show that tigers can live 13 to 19 years and probably more." The following bears it out.

A man-eater who had his "beat" in the Chendragiri forest of Ganjam District was well-known in 1913. He did most of his business on a forest road from "Cox's Corner"—named after Mr. Stephen Cox—to the edge of the *sal* jungle near Tilisingi.

Ganjam tigers are man-eaters by heredity generally, and not "by misfortune." There were nearly always several tigers in the locality referred to: but it is improbable that there has been any confusion about the identity of this particular tiger. He had distinctive mannerisms. For example, after crossing a stream-bed the road passed upwards through a cutting. Whilst a train of loaded timber-carts were labouring up the incline, out on to the road would stroll our tiger, would sit him down luxuriously and enjoy the ensuing pandemonium. Some magic or telepathy would warn him when to abstain from such performances.

In 1913 he was mature; probably not under four years old. Otherwise hecould hardly have appropriated and defended so desirable a beat. In 1915 there were five hundred rupees on his head; and one day he would have come to an end but for ill-timed politeness between myself and another man: my fault it was. I do not know exactly how many people he is supposed to have killed both before and after this occasion. Dozens and dozens.

A man-eater may seem to have been a bad institution. It must be observed though that my friend's victims were frequently women, were never above the rank of Forest Guard, and that, in a forest where the general shooting was poorish, he certainly raised the standard of his tract far above the average. To one of his exploits we owe a memorable Service Order, which run "K. Lachmana to act as Forest Guard, Fourth Grade, in Tarasingi beat, *vice* Bamsonia devoured by tiger, with effect from March 3rd, 1915."

The same tiger was there in 1920, when I left the district. In 1925 I toured in Ganjam: and once again in 1929. From what local acquaintances—forest officials and also the Khonds and Ooriyas —had to say, it was still the very same tiger.

The use of the forest road had long been abandoned; and only armed parties ventured in for thinnings, fire tracing, etc. About 1921, Mr. Shelswell, whilst looking after thinnings, was the victim of an unprovoked attack by a rogue elephant in this same place. Quite a warm corner in fact.

In 1929 March, early one hot-weather afternoon, I was watching a fire-line, along which it seemed the tiger might come back towards his kill. He came unexpectedly early and took me by surprise so that I did not make up my mind to fire quickly enough; but a mental picture of him remained. He had no tawny shades in his coat: there were the dark stripes on a dull silvery grey ground-colour. Obviously an old animal. Mr. Ware of the Veterinary Service was with me at the time. It was he and I who had had the chance at the same tiger in 1915.

After this occasion in 1929 no more was heard of the "Chendragiri Man-eater." There is no story of anyone having shot at him; but he ceased to terrorise the neighbourhood.

As far as one *can* be sure in a matter of this kind, the tiger, which must have been quite four years old in 1913, was the same tiger that was last seen in 1929. That would make him not less than 20 years old at the time of his presumed death.

A. F. MINCHIN, I. F. S.

A GREAT PLANT COLLECTOR.

By the passing of Mr. George Forrest in the Chinese Province of Yunnan on January 5th, the botanical world has lost a unique figure. Forrest got his early training under Bayley Balfour in the Edinburgh Botanic Garden, and for the last 28 years has been enriching our knowledge of the Chinese flora by making frequent plant collecting excursions. Many of the plants which he discovered in the Yunnan uplands and introduced to cultivation in European gardens are now the prime favourites of horticulture and his contributions to botanical knowledge are also represented by some 30,000 herbarium sheets, probably the best collection of Chinese flora in the world. Amongst his plant introductions were several new firs, spruces, junipers, cypresses and many different rhododendrons.

Unfortunately Forrest could never be persuaded to write a record of his experiences, though his eight journeys through Central Asia must have given him a fascinating stock of adventures, including a Tibetan massacre of his companions and a ten-day long pursuit without shelter and food, the frequent use of disguises and his unparalleled knowledge of the hill men. Many volumes on plant hunting experiences have been written by those who followed in Forrest's footsteps, for the trail he blazed as a pioneer has been followed by many others since. His success as a collector undoubtedly lay in his gifts for managing his labour, for he trained tribesmen to help him in collecting seed—which in the case of short-lived alpine annuals is a very difficult task—and these men served him devotedly, travelling half across China to meet him on his return to the Chinese Alps, and enabling him to travel so long unscathed in a land where human life is cheap.

R. M. G.

REGENERATION OF SILVER FIR.

The regeneration of silver fir (*Abies pindrow*) has been engaging the attention of Punjab Forest Officers for the last few years. The factors inimical to the natural regeneration of this species in the Kulu Forest Division have been observed to be as follows :—

(*i*) A very thick layer of undecomposed sour humus, sometimes 18 inches thick, wherein the slow growing roots of the silver fir seedlings either shrivel up or fail to strike the mineral soil.

(*ii*) Heavy weed growth, especially *Strobilanthes* spp., for the extermination of which no economic measures have yet been devised.

(*iii*) *Grazing.*—Goats eat the silver fir needles in the absence of other fodder during the winter. Heavy footed domestic animals uproot the seedlings, but the grazing incidence is very light because silver fir forests are situated in localities remote from habitation.

We have now reached a stage at which to conduct experimental operations on comparatively small areas.

The advance growth of the species has been observed to be coming up where there is a small amount of humus, up to 3 inches in depth, *viz.*, on steep slopes where it cannot accumulate to any great extent; under the canopy of broadleaf trees, where the thin leaves turn into humus quickly; and on road cuttings from which the humus has been removed.

The disposal of the raw humus is, therefore, the chief concern. Burning is not likely to succeed because (*i*) it cannot be intense in the moist and cool regions where this species grows; (*ii*) it would destroy the seed which fell in the previous winter, if resorted to in May and June, the hottest part of the year; and (*iii*) even if the area were burnt, a mass of weeds and shrubs would spring up in the rains before the seed falls in October-November. It is very difficult to induce the right-holders to rake up and remove the humus for manure since the silver fir forests are situated in areas remote from any habitation. Therefore,

in forests where an excess of acid humus is the only factor detrimental to regeneration, wide strips should be cleared of humus along the contour and the soil should be well worked in September. These strips may be continuous or interrupted and should be about 10 feet apart.

The canopy should be opened with caution for the following reasons :—(*i*) It has been observed that silver fir seedlings grow well in fairly dense shade for the first 10 to 15 years ; (*ii*) the seedlings are susceptible to desiccation and (*iii*) an open canopy would promote weed growth. Since silver fir does not produce an abundant crop of seed every year, especially in forests composed of mature, dry-topped trees, it would be as well to supplement these operations with nursery transplants.

In places where there is a heavy growth of weeds such as *Strobilanthes*, it will be necessary to clear a space around the silver fir seedlings so that they are not swamped when they are weighed down by the snow. This will have to be done every year until the seedlings grow tall enough to be out of danger. If the seedlings are properly weeded and tended it is highly probable that the regeneration of silver fir will be successful.

JALMEJA SINGH,

E. A. C. Forests, Punjab.

PYTHON MOLURUS LINN.

A specimen of this species of python was captured alive on April 23rd, 1931 by the undersigned with the help of the field staff of the Entomological Branch of the Forest Research Institute in Compartment 1, Gaula block, Lalkua, Chakata Range, U. P. The snake was found coiled around a small sized tree of *Holoptelea integrifolia* by the side of a tiny pool. It was lying apparently in ambush to attack small quadrupeds or birds that would come to the spot to drink. At first a few stones were pelted at this beast. It unloosened its coils, dropped slowly down, and tried to escape. When more volleys of stones were sent out, the snake became angry, and it darted towards us with

its mouth wide open, but repeated volleys brought the snake under control. It was taken to Lalkua Railway Station, R. & K. Railway, and despatched to Dehra Dun, the same day, packed up in a wooden crate with plenty of straw inside. The snake travelled all right. From 23rd to 29th April, it remained in this crate without any food. In the afternoon of April 30th, it was taken out and was given some nourishment and a spacious cage to live in. The cage containing this python was displayed in the Zoological show room of this Institute for about six months.

The snake, when collected, measured 10 feet 5 inches in length, and 11 inches in girth, while it was in this Institute it was observed to cast off scales on the following dates :—

1st shedding of scales on 20th June 1931.
2nd shedding of scales on 15th August 1931.
3rd shedding of scales on 26th September 1931.

Weighments were taken after the snake had shed its scales. They were recorded as follows :—

Date of weighment of snake.	Nett weight.
15th July 1931 ..	.. 24 lbs.
22nd August 1931 ..	.. 29 lbs.
5th October 1931 ..	.. 31 lbs. 1 oz.

During captivity it lived on meat and milk diet only.

On the commencement of the cold season the python ceased feeding. It seemed to undergo hibernation. No further observation on this beast was made.

The specimen was sent alive in December 1931 to Mr. Chas. Pinto, Curator, Zoological Gardens, Lahore, Punjab.

FOREST RESEARCH INSTITUTE,
DEHRA DUN,
23*rd March* 1932.

S. N. CHATTERJEE,
L. G. Asstt.,
Entomological Branch.

IMPROVING OUR MAGAZINE.

It was hardly to be expected that the *Indian Forester* would remain unaffected by the general shortage of money, and we have to report a serious drop in the sales. The average number of copies issued has dropped from close upon 900 to 660 within the last year, and we are now perilously near the minimum circulation at which the paper can pay its way. An analysis of the subscribers' list shows that the drop is largely accounted for in the reduction in "official" copies caused by divisional and circle offices cutting down their purchases, particularly where spare copies have been purchased in the past, or where the number of forest divisions has been reduced and offices combined. There is also a drop in the numbers purchased by Indian States forest departments and by individual forest officers, including Extra Assistant Conservators and Forest Rangers.

We do not deny the need for economy, but we must urge all members of the forest service to support their own service magazine. It is not an official publication, and we do not get any financial grant from Government in running it, so that it is up to individual members of the service to subscribe towards its production. There is a special rate of Rs. 10 a year for forest officers drawing less than Rs. 200 a month pay, but of the hundreds of forest rangers who might avail themselves of this, only a dozen subscriptions of this class are now received. This Rs. 10 rate hardly covers the cost price because individual issues cost roughly Re. 1 a copy, but this offer has been made in order to place it within the reach of junior officers.

Apart from subscriptions, we must also ask for support in writing articles. If there is a general shortage of cash this is no reason why there should be any shortage of ideas, but at present the magazine lives a "hand to mouth" existence, eked out with extracts from other periodicals. Extracts are of undoubted value, but most of us would prefer to see the *Indian Forester* functioning as the mouthpiece for original contributions from Indian foresters rather than as a sort of second-hand gramophone republishing the work of others.

The *Indian Forester* has now been published for 57 years and is, therefore, the oldest forestry periodical published in the English language. It forms a record of our service activities of which we may be justly proud, but it requires the active support of every forest officer if it is to maintain and improve upon its past reputation.

R. M. G.

REVIEWS.

WALDKLIMAFRAGEN.

BY H. BURGER. MITT. d. SCHWEIZERISCHEN CENTRALANSTALT f. d. FORSTLICHE VERSUCHSWESEN, XVII, 1. 1931.

This publication summarises the results of 10 years' comparative observations by the Swiss Forest Research Institute in a beech forest and in the open. The summary which is given both in French and German deals successively with the influence of the forest cover on (1) recorded precipitation; (2) duration of sunshine; (3) air temperature (screen, grass, maximum, minimum and mean); (4) humidity: and (5) evaporation. In the words of the author "it may be noted that the observations cover a long period, and have been made by a thoroughly reliable staff with fully adequate facilities. Whilst the results which have been obtained do no more than confirm already known facts, one can view them as constituting valuable confirmatory evidence." Of the bibliography of 49 items, it is expressly noted that it makes no claim to being complete, but it has a most exceptional feature for a Continental publication in that English and American and even Indian and Japanese contributions to the subject are recognised as existing and have actually been consulted. Considering the leading share Switzerland has taken in investigating the influence of forests on climate and water-supply, the article under review is particularly worth perusal.

H. G. C.

FOREST MANAGEMENT.

BY H. H. CHAPMAN, pp. 544, FIGS. 26, 1931.

The indefatigable Professor Chapman of the Yale School of Forestry, has added another volume to his well-known works on *Mensuration* (1921), *Forest Finance* (1926), and *Forest Valuation*. In English, we had already Schlich's *Manual of Forestry*, Vol. III, 5th Edition, 1925, and Recknagel's *Forest Management*, 2nd Edition, 1926, and more recently, Hiley's *Economics of Forestry*, 1930, covering

some of the same ground. The German language has no lack of text-books on the subject, the most comprehensive being by Judeich (*Forsteinrichtung*, 6th Edition, 1923), Martin (4th Edition, 1926) and Wagner (1929), and the appropriate sections of Weber's *Handbuch der Forstwissenschaft* (1927). Among all these, Recknagel's is the only one with the American outlook, and it is thus that we look to see what additional information is given in the volume under review. A glance is sufficient to show that the purposes of the two writers and the public they address are quite different. Recknagel's is virtually an elementary manual for the forestry student intended also to be intelligible to the layman timber owner and manager, whilst Chapman writes an advanced text-book aiming at covering the whole ground fairly exhaustively. We shall also at once see that Professor Chapman's treatment of the subject is his own and that special care has been given to develop it as a single theme instead of the more usual method of stringing together independent and often disconnected chapters.

The subject-matter is divided up under no less than 32 chapters, and marshalled under 290 different headings and, this, with a long subject index and a bibliography under both subject and author, are all aimed with very fair success at making the book easy for reference. It will be found, however, that the subjects are treated in a very general way, with a minimum of reference to specific cases. Preliminary matters are first dealt with in Part I which is concerned with the place of management in forestry ; Part II covers *Forest Organisation*, the underlying principles and evolution being interestingly treated in Chapters IX and X. The last part is entitled *Forest Regulation* and deals mainly with working plan compilation with discussion of Rotation, Regulation of Yield, the Normal Forest, and Control, in an interesting and comprehensive way.

From the view-point of Indian Forestry, this book is of no little interest, as providing in very convenient form an account of management as applicable to American conditions. These conditions may some times parallel those prevalent in India, just as the author notes to be the case as between North America and Europe, but the whole book is so American that leaving aside the language question, the parallel

must be continued and the decision reached that it cannot adequately meet our main requirements, which are for a work based on and illustrated from Indian forests and forestry, Trevor and Smythies' '*Practical Forest Management*' being a step in the desired direction Incidentally the latter manual does not find place in the bibliography though the ancient one written in 1898 by D'Arcy does. We shall often refer to Mr. Chapman's book to obtain the benefit of his ripe experience of American forestry and teaching, and we may often quote extracts from it, but we are unlikely to adopt it as a standard college text-book on the subject.

H. G. C.

FOREST SOIL AND VEGETATION IN THE HLAING FOREST CIRCLE, BURMA.

BY A. H. M. BARRINGTON, BURMA FOR. BULL. NO. 25, 1931.

That Mr. Barrington's 1929 publication entitled " Note on Vegetation on Forest Soils ", the first on the subject to see light in India, was of more than local interest, is shewn by the fact that the author was asked to write an abstract for the *Journal of Ecology* (see Vol. XVIII, pp. 145-150, 1930). He has now followed it up with the bulletin under review which, we are sure, will be found no less interesting and valuable.

The basic field data are derived from 53 quadrats of varying size up to one square chain, selected primarily with a view to studying the underlying facts connected with the occurrence and quality of teak, and to a less extent, of *pyinkado*. In these plots, a census was taken of the vegetation and physical and chemical analyses were made of composite samples mostly obtained from five soil auger borings, one in the centre and one near each corner. These samples were taken for depths of 0·3″, 3″—12″ and thereafter about every foot to 5 or 6 feet, the collaborating soil chemist, Mr. J. Charlton, admitting that these arbitrary depths are acceptable as different soil horizons are not thereby mixed in the soils concerned.

The reviewer noted recently in Europe that very generally foresters feel that they cannot get very much out of studies of forest soils by soil experiments investigating independently, but that close collaboration can be very productive in throwing light on problems of common interest. Naturally, as the forester has to apply the results, he likes to direct operations, but he finds at every turn that for adaptation of methods to the special problem and for interpretation of results, he must rely almost entirely on his collaborator. The present piece of work is a further illustration to the same effect, and it is always pleasing in these rather individualistic days to find such full appreciation of another's help as is given here—the expression " almost angelic assistance" does not often figure in literary acknowledgments !

Incidentally, though some may think the wording of these thanks to be on the fulsome side, Mr. Barrington is exceptional in his successful determination to lighten the usually unnecessarily ponderous tone of forest literature, but those dipping casually into the bulletin must not imagine that mention of " Sticky Point " is a humorous reference to the labours involved in getting an auger five or six feet into the soil, or even in measuring the aggregate surface of the soil particles. At the same time, it is difficult to summarise tables of physical and chemical analyses, and vegetation enumerations, in ' snappy ' style.

The bulk of the information collected is actually summarised in Diagram I which plots the soil texture index number against the moisture held by colloids at sticky point for all quadrats, and then delimits the different soil groups recognised. To interpret, soil texture index number represents the relative aggregate surface of the soil particles and the moisture figure is 16 less than the percentage of water in the sample when it just fails to stick to a clean object. Diagram II shews the distribution of the three chief species, teak, *Xylia* and *Terminalia tomentosa* superimposed on the same outline.

These forests are then classified into four types—Dry Dipterocarp, Dry Mixed, Lower Mixed and Moist Mixed, each with sub-divisions, and followed by a ' Laterite ' class which is shewn as a transition

towards Evergreen Dipterocarp, not really represented in the area. A chapter is devoted to each type (Chapter VII is misprinted as VIII), with a diagram showing the change of soil texture index with depth, and a discussion of the vegetation in the search for ' indicators '.

The final chapter gives *Provisional Conclusions* which one is tempted to condense further at the risk of unwarranted divorce from qualifying context. These main conclusions then are :—

Teak—

(*a*) Teak will not survive to maturity on heavy soils unless they are definitely calcareous, which means that they will fizz briskly when treated with dilute acid.

(*b*) First rate growth may be expected in good *kyathaung* (*Bambusa polymorpha*) forest, on well drained alluvium where the soil is not too heavy, and on heavy calcareous soils in dry mixed forest.

(*c*) Second or third rate plantations can be formed in dry mixed forest on the lighter soils whether they are calcareous or not.

(*d*) Third rate plantations can be formed on Rangoon laterite, alluvial sands derived from *indaing* soils, and local deposits of clay over coarse sand.

(*e*) Only stunted teak can be expected on *indaing* and *ingyin* soils on the one hand and heavy calcareous scrub (*taukkyante*) soils on the other.

Pyinkado.—

(*a*) *Pyinkado* is more exacting than teak and eschews all very heavy soils.

(*b*) *Pyinkado* is rare on soils in which soil moisture and soil texture are not near their optimum relationship.

(*c*) *Pyinkado* soils are all sour (low lime content) and sub-acid.

Terminalia tomentosa.—

(*a*) *Taukkyan* is probably excluded from the best soils by teak and *pyinkado*.

(*b*) *Taukkyan* is confined to ill-balanced soils with too much or too little colloidal soils for their texture.

(*c*) *Taukkyan* is probably favoured by a high percentage of lime.

Full field data are given in the appendices including methods of analysis, etc., a fact which adds more to the value of the bulletin than it does to its volume. Mr. Charlton writes in his preface that " the work attempted was a search for some simple laboratory means of classifying soils according to the forest they bear and that only useful preliminary results have been obtained. That these results justify continuance and elaboration is practically certain."

Mr. Charlton is right; the field is enormous and hardly touched. Work on agricultural soils rightly leads the way, but it is the duty of foresters to use each advance in knowledge towards a better understanding of soil factors conditioning the growth of tree crops. We must beware of generalising from inadequate data and equally of being smothered by a spate of experimental figures and lists. There is nothing like publication for inviting criticism, and for promoting adequate settling of each such flow of data so that the successive strata of knowledge may be steadily built up into a stable formation. We, and others with us, will look forward to the next instalment from Mr. Barrington, and hope his efforts will be emulated.

H. G. C.

PUNJAB FOREST LEAFLETS No. 2.

By C. G. Trevor, Chief Conservator of Forests, Punjab.

This publication contains much that should not be allowed to pass unchallenged.

Epilobium, *Indigofera*, *Desmodium* and raspberry are mentioned as " nitrotrophilous " plants. We were in doubt as to whether nitrophilous or nitratophilous plants were meant. The mention of *Epilobium* and raspberry shows that Hesselman's views have been accepted. Hesselman says that *Epilobium angustifolium* and *Rubus*

idaeus are strongly nitratophilous. (Tansley gives both as characteristic of sandy soil and Clements quotes the former as a fire indicator). There are at least 8 species of *Epilobium* in the West Himalaya :—are we to assume on no experimental evidence that all are " nitrotrophilous "? Why mention " raspberry " at all when it is not found in the West Himalaya ? *Indigofera* and *Desmodium* are mentioned as " nitrotrophilous " plants ; are we to understand that all the species of both genera are to be included ? Since according to Marshall " it is generally agreed that legumes assimilate nitrate nitrogen more rapidly than non-legumes " why specify only 2 genera and not the whole family, *Leguminosae*. As it is well-known that legumes will grow on soils deficient in nitrogen and in view of the fact that Rothamsted experiments and others have shown that leguminous plants are more or less independent of nitrogenous compounds in the soil and are liable to be injured by an excess of them, we should like some evidence before accepting any leguminous plant as being nitrotophilous in the sense that *Epilobium* and raspberry are said to be.

We are told that " much has been learnt in the last decade regarding the significance of the plants comprising the ground flora " and we suggest a little attention to spelling during the present decade. When one sees " *Ainslia* " and " *Spirea Sorbifolia* " one is apt to conclude that the rest of the matter is at the same level. We are told that when balsam, *Strobilanthes* and *Plectranthus* are dominant, conditions are quite unsuitable for regeneration. Apparently it is not realized that there are at least 14 species of balsam in the West Himalaya and the conditions under which these grow are very diverse. Similarly for the other genera. The statement, therefore, as it stands is valueless and likely to be misleading.

The ideas regarding the influence of light on germination are crude and inaccurate. We are told that neither deodar nor blue pine make heavy demands upon light for germination. A little thought shows that light is not required for germination, otherwise seeds buried in the ground would never germinate. We are told that " moisture is very largely dependent on light," " so me of the mother-trees invariably die of isolation " and " only large crowned mature

trees produce regeneration." In forestry trees are "isolated" by having a trench dug round them when they have been attacked by a root fungus liable to spread to the neighbouring trees. Such trees die as the result of the fungus and not from lonesomeness like the rathe primrose that forsaken dies.

"All seed-bearers of both deodar and blue pine must be well-developed trees of past middle age." To be past middle age we imagine the deodar seed-bearer should be about 400 years old but the blue pine need not be more than 100 years old and probably 75 years would just count as middle age. This is for favourable conditions and might be reduced somewhat where conditions are not ideal.

"A percentage of 25 to 33 per cent. of deodar in mixed crop is sufficient." Possibly, but why make the sentence so obscure ? As the percentage has been left ambiguous it seems scarcely necessary to introduce a further safeguard. This sentence is easier to follow if amended thus "A percentage of 33 per cent. of deodar in mixed crop is sufficient."

"Excessive grazing and grass-cutting is always injurious in areas under regeneration." Why specify areas under regeneration ? Excessive grazing is obviously always injurious otherwise it is not excessive so why say so ? "Once grazing and grass-cutting can be permitted without detriment to the young regeneration the area can be opened for these purposes at the discretion of the Divisional Officer." It should, however, be impressed upon the latter that an area fit for "once grazing" is not necessarily fit for twice or thrice grazing.

"The standard routine tending operations in regeneration areas are (*ii*) weeding of excess undergrowth." This seems pure waste of time and it would be far better to leave the excess undergrowth unweeded in the hope that weeds suppress some of it.

We are told that in the Punjab in regeneration areas pole crops are retained as part of the new crop. The diameter fixed for retention applies to the diameter at the time of the introduction of the working plan. Consequently in marking for regeneration the marking officer has to consider how much the crop has grown since the working plan

was introduced. Thus when marking in the first year of the currency of the plan, pole crops up to 6 in. diam. may be retained, 5 years later pole crops up to 7 in. diam. may be retained if the trees have increased 1 in. in diameter in 5 years and so on throughout the currency of the working plan. This seems an unnecessary complication and subordinates silvicultural considerations to an ephemeral and arbitrary working plan prescription.

R. N. P.

RECENT FOREST RESEARCH INSTITUTE PUBLICATIONS.

We note that one of the recent F. R. I. Publications (Vol. XV, Part IV of Indian Forest Records, Silviculture Series) is a Volume Table for *Semal* (*Bombax malabaricum*) by Mr. Ishwar Das Mahendru. This officer has shared in the work of several previous publications, having been joint-author with Mr. H. G. Champion in producing Volume and Yield Tables for Blue Pine; Volume Tables for *Katha* and *Khair*; and the Statistical Code Manuals. Mr. Mahendru is to be congratulated on completing this further useful piece of work on *semal* and in producing his first individual publication.

The *semal* occurs throughout the Sub-Himalayan tract and reaches an enormous size in the open grassy lands of the *tarai* and outer *bhabar*. It has recently come into prominence through the rapid development of the match-making industry, as its wood is suitable both for box covers and splints. The tree frequently reaches an enormous size, one in Bihar being reported as 115′ in girth round the buttresses with each buttress from 13′ to 24′ in length, " with enough space to stable an elephant " between them.

The presence of these huge buttresses complicates the life of the Statistical Officer, and the means taken to deal with the problem of measuring such trees is most interesting. " In the case of buttressed trees, the difficulty which arises is got over to some extent by shifting the measurements (girth at breast height) to a point where the buttress formation ends or, at any rate, is imperceptible. Very often, however, it is not feasible to take the measurement at this point as it is out

of reach, and involves the use of a ladder or similar device. In such cases a visual estimate of the size is the only measurement available, and this obviously cannot be reliable. A table of " normal diameter " corresponding to different girths round the buttresses at breast height has been compiled to meet this practical difficulty. By *normal diameter* is here meant the theoretical average diameter at breast height of a buttressed tree of known girth round the buttresses at breast height, on the assumption that the taper of the lowest unbuttressed log is continued to the ground. From this normal diameter, the commercial volume of a tree of known girth over buttresses can be estimated within the indicated limits of error, using any of the tables given."

* * * * *

The Silviculturist's Branch is also to be congratulated on two other very interesting Records (1) The Use of Stumps (Root and Shoot Cuttings), Vol. XVI, Part VI, and (2) Notes on *Pinus longifolia* (Plantations in Dehra Dun and Central Provinces), Vol. XVI, Part VII, both by H. G. Champion and B. D. Pant.

(1). The use of stump cuttings in all provinces and for many of our most important species has had an amazingly rapid spread and is a subject worthy of the skill and care which have been expended in writing up the history, experimental methods, and the results of a large series of experiments on stumps. Emphasis is rightly laid upon the need for preventing injury to the plant in preparation and handling, for although the stump cuttings of many species are extraordinarily hardy there is no doubt that the use of a blunt instrument for pruning does tend to cause disease by loosening the young bark from the stem.

It is also reassuring to find that no trace of rot could be traced after three or four seasons' growth, for this removes one of the "bogeys" introduced from European practice, namely, the fear of rot developing in a root-pruned surface.

(2). An interesting account is given of *chir* pine as an exotic in plantations on level agricultural lands below the limit of its natural

distribution. Some excellent photographs show the progress of the *chir* grown in *taungya* cultivation in Dehra Dun where it did best with *Sesamum* crops. *Chir* is apparently one of the few forest seedlings which thrives if left unweeded, and this is put down to the brittleness of the seedlings which are easily broken if touched ; the cutting back of tall grass and heavy herbaceous weeds is, however, recommended. The extraordinarily rapid early growth of the *chir* in such areas is not maintained and the height growth falls off after reaching 10 years.

* * * * *

The Entomological Series of the Indian Forest Records is continued with the publication of the following :—

Vol. XVI, Part IX.—Life History and Control of *Celosterna scabrator*, by C. F. C. Beeson, I.F.S.

" Part X.—New Species of *Exocentrus Mulsant* from India, by W. S. Fisher, U.S. Dept. Agric.

" Part XI.—Immature Stages of Indian Coleoptera (No. 10), by J. C. M. Gardner, I.F.S.

* * * * *

We would suggest that the "Statistical Code Manuals" series issued from the Silvicultural Branch of the Forest Research Institute should be more widely advertised. There is much useful information in these manuals which the younger forest departments throughout the Empire and in other countries might be very glad to have when starting statistical work of their own, but so far as we are aware these publications are only advertised in the complete list of Forest Publications printed twice yearly in the *Indian Foresters.* They are not even mentioned in the list of Forest Research Institute publications which accompany new Records.

R. M. G.

SYLVA, 1931-32.

A perusal of the twelfth annual issue of the Edinburgh University Forestry Society's magazine will bring a reminiscent light into the eyes of many forest officers scattered round the world, for in addition to a goodly number in India and Burma, there are Edinburgh-trained

men in most of the colonial and dominion forest services ; in fact one might aptly quote the Australian who said, *à propos* of pests, that the Scotsmen were almost as bad as the rabbits ! The list of some 200 past students certainly shows that they are well-nigh ubiquitous.

The accounts of the third year pilgrimage to France to spend a summer term in the Landes and the oak forests of the Allier sound refreshingly familiar, even down to the Rugby "international" against a local French team, and the reunion dinner with the French forest officers. This year the latter took place at Moulins and was the occasion for presenting Professor Stebbing with the decoration of Chevalier du Merite Agricole.

There are several interesting articles, notably on the planting of *Eucalyptus rostrata* and *saligna* as an aid to draining swamps in Uganda, and a description of the timber testing and seasoning plant recently built by the South African Forest Service at Pretoria. There is a note by Dr. Mark Anderson advocating the full trial of very densely planted groups spaced out at wide intervals for the production of clean timber in plantations ; a fuller account of this system by the same writer appeared in the October 1930 number of the Scottish Forestry Journal, and is well worth close study by all officers dealing with plantation problems.

The following priceless babu-isms are too good to miss handing on :—A telegram from a ranger : " House burnt down, life in danger, please arrange." And an application from a clerk for a rise in pay : " Thus, kind sir, is it clear that neither by hooks nor by crooks can I make my two ends meet."

The younger generation of forestry students is to be congratulated on keeping up the standard of *Sylva*, which is a unique contribution to forestry literature and has the saving grace, from a reviewer's standpoint, of a leaven of good jokes.

R. M. G.

FOREST ADMINISTRATION IN THE UTILIZATION CIRCLE, BURMA. FOR 1930-31.

This annual report ot the Forest Utilization activities of Burma is, as usual, full of interesting information. In addition, it is brief and to the point, and the writer is to be congratulated on not wasting time and money by including a lot of useless and unnecessary information.

Experimental and research activities were continued unabated, but in the extraction divisions, work was greatly hampered by the rebellion, which cost the Forest Department three valuable lives and considerable financial loss. Fourteen forest buildings were burnt down by rebels and 15 forest officials were deputed to military duty in this connection, with the result that forest work was badly dislocated for some time.

On the research side, the chief items of interest included work on the Burma mahoganies, a further study of the beehole borer of teak, and a continuation of the experiments on teredo damage to timbers in Rangoon harbour. A good deal of attention was also paid to kiln-seasoning, and the small scale experimental kilns proved both economical and valuable. The cost of kiln-seasoning in the Timber Research Division is still very high. It stands at Rs. 5/6/- per cubic foot which is too much for commercial activities. Every effort is being made to lower this figure. Another important item in seasoning research was a trial of the effects of frequent steamings on the wood of *Terminalia tomentosa*. The results were quite promising and may lead to an improvement in the seasoning of this very common but very difficult wood.

In the Wood Working branch some very useful work was achieved, and some big orders for furniture and fittings were executed. The new Law Courts in Rangoon bought furniture to the value of Rs 29,000. Tool handles of *yon* (*Anogeissus acuminata*) also proved a good market, and no less than 27,000 handles were sold to the Burma Railways and local commercial undertakings. Other good markets were floor blocks of *padauk* (*Pterocarpus macrocarpus*), *haldu* (*Adina cordifolia*)

and *thinwin* (*Millettia pendula*), and printing blocks of kiln-seasoned *binga* (*Mitragyna diversifolia*).

The financial results of the year's working were on the whole satisfactory, when the unsettled condition of the country and the general world-wide drop in prices are taken into consideration.

The total revenue for the year was Rs. $17\frac{3}{4}$ lakhs as compared with Rs. $30\frac{1}{2}$ lakhs for 1929-30, and Rs. 21 lakhs for 1928-29. The expenditure, however, dropped to Rs. 2 lakhs, as against Rs. 4 lakhs for the previous year. The surplus was, therefore, Rs. $15\frac{3}{4}$ lakhs for the year under review which, taking into consideration the difficulties of the year, cannot be considered unsatisfactory.

As the Circle is worked as a commercial concern, the true criterion by which the financial results should be judged is the dividend it is able to pay. The capital invested is Rs. 87 lakhs, and after charging interest at 5·1 per cent. on this capital, the profits yielded a dividend of 7 per cent., which in these days of acute economic depression may be considered as very satisfactory.

In conclusion, the report is well printed and remarkably free from printing errors. On the other hand, the price, namely Rs. 3, appears to be unduly high for a publication of this sort in a paper cover with only 60 pages of print. Even the *Indian Forester* with over 60 pages and several good illustrations is sold at a profit at Rs. 1-4-0 per copy!

H. T.

ADMINISTRATION REPORT OF THE FOREST DEPARTMENT OF THE MADRAS PRESIDENCY FOR THE YEAR ENDING 31ST MARCH 1931.

During the year under review the Government accepted the proposals of the Chief Conservator for the reorganization of the Forest Department. This provides for steady development on recognised principles of forest management and it is gratifying to read that the Working Plans Circle is to be retained. The Forest College for training the executive staff is also retained, while a Forest Utilization

Officer is provided to market the forest produce. A Forest Engineer is also provided to whom major works of construction will be entrusted and it is very satisfactory to note that provision has been made for a second Provincial Silviculturist. The great necessity for this additional post was referred to in the previous year's report.

It was unfortunate that the year in which this reorganization scheme came into force proved so bad from a financial point of view. The demand for timber and other produce did not equal the supply and the prices obtained were in many instances far below normal. This was especially so in the case of sandalwood which is one of the main revenue producing products of the Madras forests. During the year 900 tons were available for sale but in was only possible to dispose of 546 tons, while the average price obtained was not much more than half that obtained in the previous year.

Good progress was made with the preparation of Working Plans, and at the close of the year Working Plans or schemes were in existence for 9,422 square miles, while Working Plans for 3,309 square miles were awaiting sanction or were under preparation, leaving 6,330 square miles for which no Working Plans had been started.

The total output of timber was 85,580 tons or 11·7 per cent. less than the figures for the previous year and there was a slight increase in stocks remaining undisposed in depôts at the end of the year. The accumulation was principally in the Wynaad and Nilambur Divisions and was due to the unusual slump in the timber market, a result of the world-wide economic depression. 234,825 tons of fuel were removed from Reserved or Leased forests, of which 13,800 tons were removed by departmental agency. The slight decrease (1,350 tons) removed by departmental agency was mainly due to the stoppage of the supply of charcoal to the Kurnool Municipality and to the abandonment of the manufacture of charcoal in Anantapur. The value of the bamboos removed dropped from Rs. 4·55 lakhs to Rs. 3·94 lakhs due to the poor prices realised for coupes on account of trade depression.

12·36 per cent. of the forest managed by the Forest Department was closed to grazing throughout or for part of the year. Grazing permits were issued for 1,531,661 animals as against 1,649,805, while free grazing was provided for 86,135 animals. The decrease in the animals grazed is attributed to cattle mortality by epidemic diseases in all the circles and to the late setting in of the monsoon in Ganjam, Vizagapatam and Guntur. Even so, the incidence of grazing is 5·5 acres per animal as compared with 5·7 acres in the previous year, the figure being as low as 2·27 in Lower Godaveri. As is pointed out, these figures show that reduction in grazing incidence is urgently called for, but this appears to be impossible as long as Government adhere to the policy of " no enhancement of grazing fees " and as long as the range-wide system is not replaced by the old block system. The grazing rates are far below the market value of the grazing and the question of increasing the existing rates is well worth reconsideration as a legitimate means of improving the financial resources of the State.

The revenue derived from the sale of the right to collect minor forest produce showed a substantial decrease due to the poor prices realised on account of trade depression and due to the failure of the tamarind crop in the First and Fourth Circles. Experiments in lac cultivation were continued in certain areas and met with a fair amount of success, but it has been decided not to make further developments until the market shows a decided improvement.

The estimated value of forest produce removed free showed a slight increase and amounted to Rs. 85,120. Most of the free grants were, as usual, for the reconstruction of houses destroyed by fire.

Considerable space is devoted to the results of the year's working, the financial and business aspects both present and prospective, of the commercial concerns of the department. A great many of the commercial concerns in question were closed down in the previous year and the report in such instances is concerned with the steps taken to wind them up. It would appear that no steps have yet been taken to put an end to a principle under which forest management is subordinate to the system of accounting, reference to which was made in the previous year's report.

Natural regeneration is reported to have been fairly satisfactory in most districts; but, as usual, it was found that after satisfactory germination of seed in the rainy weather, many seedlings wilted and died during the dry hot season of the year. The same conditions resulted in the case of artificial regeneration by sowings, but, when planting of seedlings or stumps, as in the case of teak, was followed by a sufficient number of days of favourable weather, the results were satisfactory. Sandal is reported to be spreading naturally in several districts and there appears to be little doubt that the species is on the increase in spite of the ravages of spike disease. The knowledge of the silviculture of this species has increased appreciably during the last few years and is to be embodied in a pamphlet which will be distributed widely.

Steps were taken in some districts to improve the growing stock in the fuel coupes, but the work is still mainly in an experimental stage. The progress made in the formation of teak plantations was reported to be satisfactory, while it is interesting to record that satisfactory results have been obtained in the artificial restocking of gaps in the evergreen forests and that no anxiety is felt about the artificial regeneration of this type of forest.

Elephant-capturing operations were conducted as usual and an instance is recorded in the Nilgiris Division in which a Forest Guard and two Kurumbars located a herd of elephant beside the Moyar river and drove them very slowly for about a mile down the bank of the river to a ford opposite which was a row of elephant pits. When the elephants entered the water at the ford, the Forest Guard stampeded them with the result that seven of the elephants fell into pits.

Investigations into forest offences by District Forest Officers and Range Officers are reported to have improved, though there is considerable room for improvement.

The area burnt by fire, in areas in which special fire protection was attempted, rose from 349 square miles (8·3 per cent.) to 372 square miles (9·05 per cent.), the bulk of the damage having been in the First Circle as usual. Reference is made to the necessity for closing to

grazing, areas which have been burnt, and it is stated that this practice is not followed to the extent that it should be.

Damage by defoliators continued in Nilambur Division and a special Forester was employed for the collection of statistical data for the Forest Entomologist, Dehra Dun, by whom the problem is being investigated. Damage is also reported by wild animals from various divisions, especially in teak plantations.

There was a very big drop in revenue as has been the case in most provinces. The surplus was Rs. 2·18 lakhs, to which must be added a surplus of Rs. 1·82 lakhs on the commercial undertakings, making a total surplus of Rs. 4·30 lakhs as compared with a surplus of Rs. 15·35 lakhs in the previous year. There was a decrease of Rs. 6·50 lakhs in the revenue derived from forest produce removed by Government agency (Rs. 5·49 lakhs of this was due to a decrease in revenue derived from sandalwood), while the decrease from produce removed by consumers and purchasers was Rs. 5·28 lakhs. The decrease is attributable entirely to trade depression and it is to be hoped that a trade revival will have a beneficial effect on forest revenues.

The report closes with an account of the special measures taken to protect the jungle tribes and a reference to the health of the subordinate executive staff. This was, as usual, bad in the specially malarious districts, but as is pointed out, the fight against malaria must necessarily be an uphill one in centres of forest work which are continually changing. Three Forest Guards and two Watchers were murdered in the discharge of their duties—events significant of the times covered by the report.

F. D. A.

EXTRACTS.

TIMBER USED IN CARRIAGE AND WAGON SHOPS IN INDIA DURING 1930-31.

EXTRACTS FROM REPORT BY H. C. B. JOLLYE, I.F.S., TIMBER ADVISORY OFFICER WITH THE RAILWAY BOARD.

Analysis of returns showing quantities of various timbers used.

Item No.	Trade Name.	Botanical Name.	Quantity Tons, 1929-30.	Quantity Tons, 1930-31.	Remarks.
1	Teak (Burma) ..	Tectona grandis	28,292	21,500	Recommended that a proportion of high class squares should be purchased and kept separate for bottom sides only. For other purposes a trial of log ends is suggested. Scantlings cut to railway sizes are available at favourable rates.
2	Teak (Indian) ..	,, ,, ..	5,289	3,812	Exceptionally large sound logs are available in Malabar. Carriage constructed in 1928 of C. P. teak reported quite satisfactory in November 1931.
4	Sal ..	Shorea robusta ..	3,092	1,315	
	Deodar ..	Cedrus deodara	1,940	2,150	Reported on as sound after 5 years as casing boards, wearing well. Average price of sawn timber fell 26 per cent. from Rs. 1-5-2 in 1929-30 to Re. 0-15-8 per cubic foot in 1930-31.
5	Padauk (Andaman.)	Pterocarpus dalbergioides.	1,379	1,611	Chiefly Andaman. Direct supplies can now be arranged. Interior panelling (1926) reported very good.
	,, (Burma)	Pterocarpus macrocarpus			Burma Padauk has proved excellent for floors.
6	*Bonsum ..	Phoebe hainesiana.	500	356	This timber is often marketted as Assam Teak. It is not Teak and should be ordered as Bonsum.
7	Maiyang or Eng	Dipterocarpus .. tuberculatus	433	1,339	Reported on as being as good as teak for floor and ceiling boards after 5 years service. Maiyang is the Siamese name for the timber called Eng in Burma.

Item No.	Trade Name.	Botanical Name.	Quantity Tons. 1929-30.	Quantity Tons. 1930-31.	Remarks.
8	*Gurjan ..	Dipterocarpus turbinatus and allied species.	348	652	Similar to Eng and Maiyang and sometimes substituted. Chiefly obtained from the Andamans.
9	*Haldu ..	Adina cordifolia	515	866	Reported sound after 5 years as casing boards. Sound cylindrical logs averaging 15 to 20 ft. long and 6′ 6″ in girth obtainable from Nepal at Rs. 65 per ton.
10	Jaman ..	Eugenia jambolana.	..	405	Also called Nerale. Used for bottom boards.
11	Poon ..	Calophyllum species.	142	562	Available in very large sizes and good for bottom boards. Panels built up of two veneers on a laminated core prepared by the Forest Research Institute, Dehra Dun, have been used in a 1st class compartment this year.
12	Shisham .. Indian rosewood	Dalbergia sissoo Dalbergia latifolia.	116	239	Of which 200 tons were Dalbergia sissoo. Used for dining car furniture.
13	Laurel ..	Terminalia tomentosa.	19	623	Also called Asna, Saj and Matti. See item 37.
14	Kindal ..	Terminalia paniculata.	..	84	Also called Honal. Reported sound after 5 years as casing boards.
15	Badam ..	Terminalia procera.	111	50	From Andamans. Available in large quantities.
16	White chuglam	Terminalia bialata.	19	14	From Andamans.
17	*Hollock ..	Terminalia myriocarpa.	..	26	From Assam. Well reported on locally after 9 years' experience in carriages. Used for sleepers after impregnation. Partition boards (1927) well reported on in November 1931.
18	Benteak ..	Lagerstroemia lanceolata.	71	325	Reported sound after 4 years as floor and roof boards.
19	*Tavoy wood ..	Parashorea stellata.	..	412	Should not be used in exposed situations.
20	*Ramdala (lampatti)	Duabanga sonneratioides	5	230	

Item No.	Trade Name.	Botanical Name.	Quantity Tons, 1929-30.	Quantity Tons, 1930-31.	Remarks.
21	Chaplash ..	Artocarpus chaplasha.	..	173	
22	*Cham ..	Michelia champaca.	3	132	
23	*Jarul or pyinma	Lagerstroemia flos-reginae.	88	170	Andaman Pyinma. Floor boards (1916) slightly warped but satisfactory.
24	*Toon ..	Cedrela species	18	92	Veneer Panels with laminated cores have been prepared by the Forest Research Institute, Dehra Dun, for a 1st class compartment.
25	Irul ..	Xylia dolabriformis.	..	32	
26	Bija Sal ..	Pterocarpus marsupium.	340	372	Also called Honey.
27	Babul ..	Acacia arabica	93	67	Chiefly for keys. Satisfactory for carriage door and side pillars.
28	*Thingan ..	Hopea odorata	..	76	A high class timber.
29	Dhaman ..	Grewia tiliaefolia	..	12	Also called Thadsal.
30	Jack ..	Artocarpus integrifolia.	..	13	Also called Hebblesu.
31	*Yon ..	Anogeissus acuminata ..	..	6	From Burma. For hammer shafts. Increasing demand, 25,000 sold in Burma.
32	Semal ..	Bombax malabaricum.	26	32	Dust shields for axle boxes.
33	White cedar ..	Dysoxylum malabaricum	1	7	The White Cedar from Burma has now been identified as Amoora Wallichii. Trade name Amoora.
34	Aini ..	Artocarpus hirsuta.	97	7	Recommended. Excellent substitute for teak.
35	Vellapiney (Belapine)	Vateria indica ..	47	1	Not recommended. Vernacular name Piney maram.
†36	Malabar Junglewood.	Mixed species ..	375	296	Chiefly bottom boards.
†37	Miscellaneous Hardwoods and Junglewoods.	..	†3,100	1,669	†Included considerable quantities of item 13-Laurel.

NOTES.

*Species included among those selected for the kiln seasoning experiment at Lillooah, East Indian Railway.

†Nos. 36 and 37. It is requested that as far as possible a record may be kept in future of the species purchased.

Full description of most of the above timbers will be found in Trotter's "The Common Commercial Timbers of India and their Uses," available from the Government of India, Central Publication Branch, 3, Government Place, West, Calcutta, price Rs. 1-12-0.

Item No.	Trade Name.	Botanical Name.	Quantity Tons, 1929-30.	Quantity Tons, 1930-31.	Remarks.
		Foreign Imported Timbers.			
38	Hickory ..	Hicoria species	39	14	Imported for hammer shafts. Yon, item 31, has proved a good substitute for hickory. Olea ferruginea (kow) and Parrotia jacquemontiana (parrotia) are equally good.
39	Red Lauan ..	Shorea negrosensis and other species.	..	147	From Philippines.
40	White Lauan ..	Shorea mindanensis and eximia.	..	50	From Philippines.
41	Java Teak ..	Tetramerista glabra	..	50	From Java. Described by Dr. Foxworthy, Timber Research-Officer, Philippine Islands. "The wood will decay if left in contact with the ground. Subject to white ant attack. Dries out slowly." It is not Teak, but is sold in India as "Golden Teak." Very subject to fungus attack.

REMARKS.

The total amount spent on timber, other than sleepers, by Class I Railways during the financial year 1930-31 was Rs. 84·50 lakhs compared with Rs. 104·47 lakhs in 1929-30. The decrease in expenditure is chiefly on account of reductions made in construction programmes owing to the abnormal financial situation, but partly owing to the increased purchase of cheaper timbers. In 1931-32 programmes have been still further reduced.

The following comparisons are interesting :—

Year.		Total amount of timber consumed.	% of total Burma teak.	% of total Indian teak and Indigenous timbers.
		Tons.		
1927-28	..	34,000	69	31
1929-30	..	45,000	57	43
1930-31	..	42,000	50	50

Indian teak.

		Tons.	
1927-28	..	700	(2 % of total consumption),
1929-30	..	5,300	(12 % ditto.).
1930-31	..	4,000	(10 % ditto.).

Indigenous timbers, other than teak.

		Tons.	
1927-28	..	9,800	(29 % of total consumption).
1929-30	..	14,200	(31 % ditto.).
1930-31	..	17,000	(41 % ditto.).

From the above broad classification the general deduction may be drawn that the tendency to resort to cheaper timber, especially for repair work, has rapidly increased. The use of indigenous timbers on the North-Western Railway has risen from 59 per cent. to 77 per cent., and on the East Indian Railway from 32 per cent. to 47 per cent. The total consumption of each of these two railways is one of the highest.

The following information as regards the prices at which specially selected consignments of indigenous timber were purchased may prove useful :—

Trade Name.	Origin.	Size.	Price Rs. per ton.
Haldu ..	Burma ..	5′ 6″ girth ..	86 c. i. f. Calcutta.
,, ..	Nepal ..	5′ 6″ ,, ..	65 f. o. r. R. and K. Railway.
,,	Bihar ..	5′ 6″ ,, ..	68/12 f. o. r. Cuttak.
Chaplash ..	Andamans ..	12″ 15″ sidings 20′ and up.	85 f. o. r. Howrah.
Chikrassy ..	Burma ..	..	38 f. o. r. Rangoon.
Badam ..	Andamans ..	Average 25 c. ft. ..	70 f. o. r. Howrah.
Amoora ..	Burma ..	..	45 f. o. r. Rangoon.
Burma Padauk ..	Burma ..	(a) 5′ girth .. (b) 18″ squares ..	96 c. i. f. Calcutta. 105 c. i. f. Calcutta.
Bonsum	Assam ..	Average 27 c.ft. ..	75 f. o. r. A. B. Railway.
Tavoywood ..	Burma ..	16″ square ..	100 c. i. f. Calcutta.
Hollock ..	Assam ..	27 c. ft. square ..	75 f. o. r. A. B. Railway.
Ramdala ..	Assam ..	Square ..	75 f. o. r. A. B. Railway.
,, ..	Assam ..	30 c. ft. round ..	60 f. o. r. A. B. Railway.

The amount of timber imported from abroad for use in railway workshops is almost negligible, but in one case Philippine and in another Java timber have been purchased. It is clearly desirable to avoid this, if possible, especially when the trade in India is suffering from lack of orders.

The kiln-seasoned indigenous timbers in carriages under observation have all been reported on favourably up to date. All this timber was kiln-seasoned at the Forest Research Institute, Dehra Dun. It is too early yet to report on carriages constructed of timber kiln-seasoned at Lillooah.

I shall welcome enquiries on any subject in connection with the purchase or use of timbers and shall be obliged if the results of calls for tenders are reported to me.

SANDBLASTING ON WOOD.

Sandblasting on wood for decorative effect has now been proved successful, but as yet it has only been used with Douglas fir, red cedar and hemlock, although other woods would undoubtedly be adaptable.

The process consists of cutting the design required on a stencil made of heavy manilla paper which is glued to the panel. A blast of rough, sharp sand at a high intensity is applied to the surface which etches away the exposed part of the stencil design and leaves the covered parts outstanding in bas relief.

Sandblasting is a process much used for metal work, but had not till recently been utilised on wood.—(*Timber Trades Journal, 27th February* 1932).

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THE IDENTIFICATION OF THE GARJANS (DIPTEROCARPUS SPP.), COX'S BAZAR DIVISION, BENGAL.

BY R. I. MACALPINE, I. F. S.

Four species are common in the Division and though Mr. Parker suggests that hybrids may exist, I have not come across any, and for all practical purposes it may be said that *D. alatus*, *D. costatus*, *D. turbinatus* and *D. pilosus* are the only ones found.

Their identification is best done by the fruits which can be classed as follows :—

A.—FRUIT BODIES WITH RIBS.

(*i*) *D. costatus.*—Ribs projecting at most one-eighth of an inch from the fruit body. Whole fruit covered by reddish brown hairs.

(*ii*) *D. alatus.*—Ribs projecting half an inch from the fruit body and forming papery wings.

B.—FRUIT BODIES WITHOUT RIBS.

(*iii*) *D. turbinatus.*—Fruit body fusiform with marked striations particularly noticeable in the mature fruit.

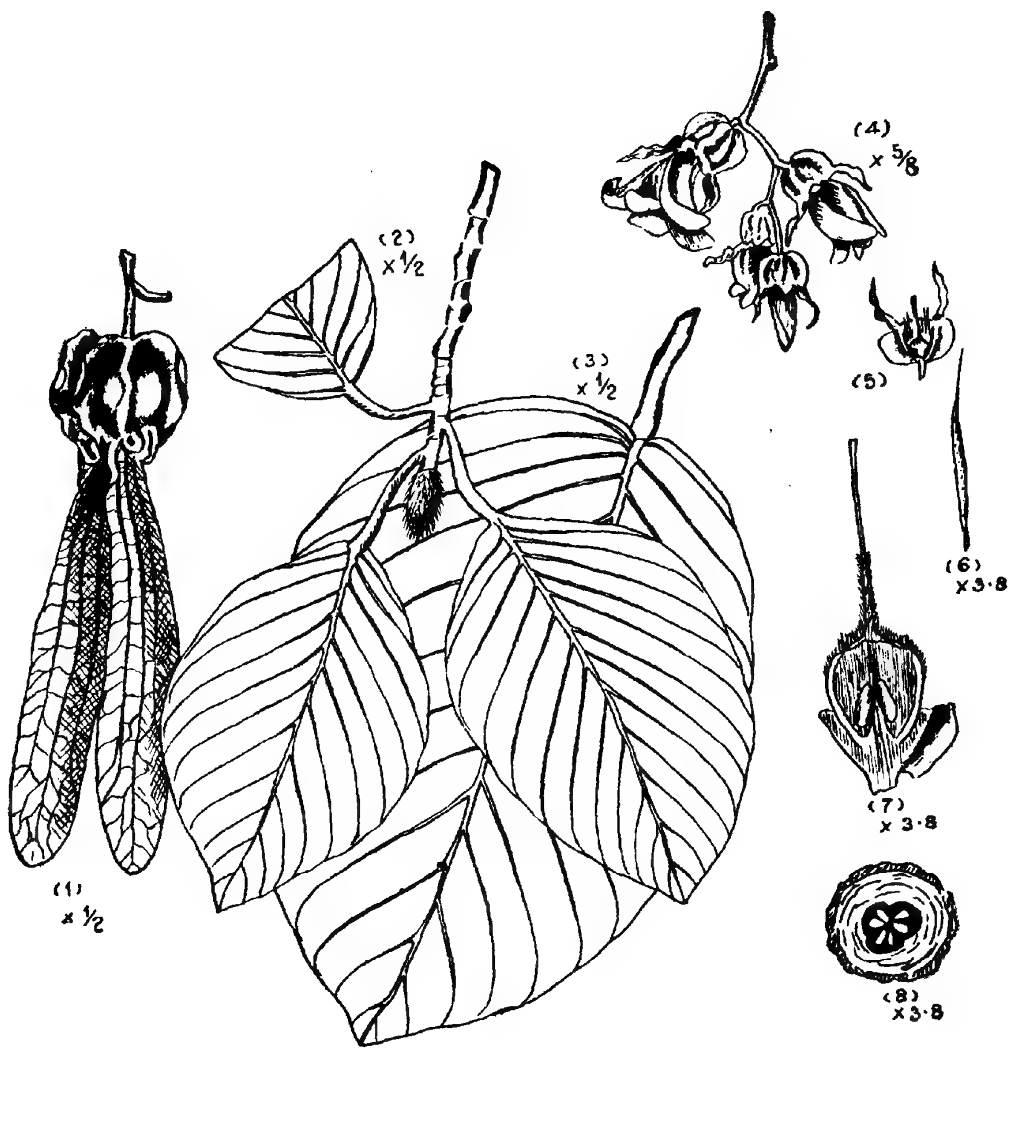
(*iv*) *D. pilosus.*—Fruit body round, and without striations.

The distinction between the last two is not easy and an additional guide is the venation of the wings. In *D. pilosus* the three veins of the wings are all prominent and reach to two-thirds of the length of the wing, whereas in *D. turbinatus* the middle vein only is prominent, the two side veins losing themselves about half way up the wings.

The following "Field" distinctions are of value when fruits are not available :—

	D. turbinatus.	*D. pilosus.*	*D. costatus.*	*D. alatus.*
Crown ..	Heavy looking and dark.	Heavy and dark	Large but not heavy looking as leaves small. General colour yellowish green.	Heavy and dark.
Trunk ..	Not glaringly white.	Glaringly white.	Not glaringly white.	Glaringly white.
Bark ..	Fissured longitudinally exfoliating in strips.	Not fissured to any great extent, exfoliating in roundish flakes.	Fissured longitudinally exfoliating in strips.	Not fissured and exfoliating in round flakes.
Leaf ..	Large, brilliant green, glossy and smooth on both surfaces. No trace of pubescence in young leaves. Petiole covered with waxy bloom.	Mediumly large, brilliant green, distinctly hairy in young leaf, almost smooth in old leaf. Leaf edges fringed by hairs.	Small, yellowish green, distinctly hairy on both sides of leaf. Young leaf covered by reddish brown long hairs. Leaf edges fringed by reddish brown hairs.	Large, slightly cordate; upper surface rough; under distinctly hairy with buff pubescence.
Leaf bud ..	Whitish in colour, waxy rather than pubescent.	Smooth to hairy.	Very hairy with long reddish hairs.	Dingy grey pubescence, very thick.
Old twig ..	Smooth and glossy brown. Marked lenticels.	Smooth, with hairs on leaf scars; dark brown.	Markedly hairy, reddish brown.	Hairy, brown.
Young twig	Smooth and whitish passing to brown, markedly flattened. Marked lenticels.	Smooth to lightly hairy. Hairs long & whitish: round.	Markedly hairy, reddish brown; round.	Dingy grey pubescence on upper surface, light buff on lower, less pubescent lower down; round.

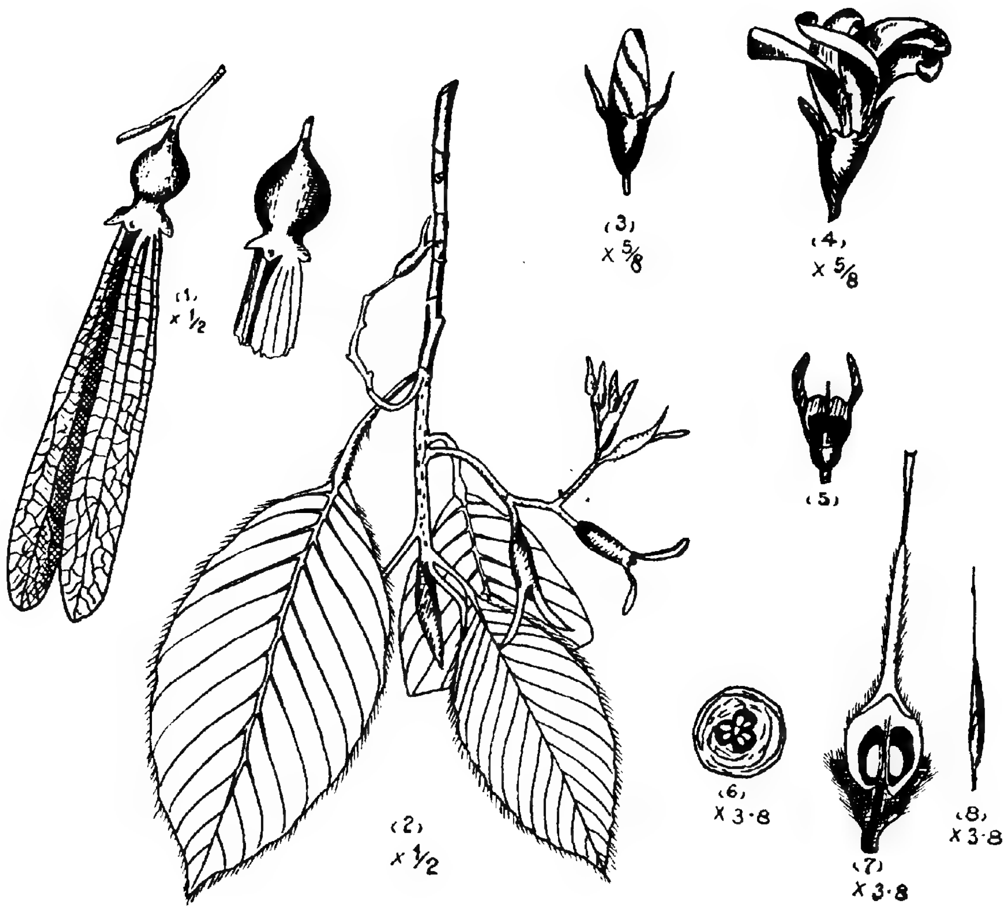
DIPTEROCARPUS ALATUS.



1. Fruit. 2. Branchlet. 3. Leaf from top shoot. 4. Raceme with opened and unopened flowers. 5. Longitudinal section of flower with petals removed. 6 Stamen. 7 Longitudinal section through ovary. 8. Transverse section through ovary.

R. I. Macalpine.
19/12.

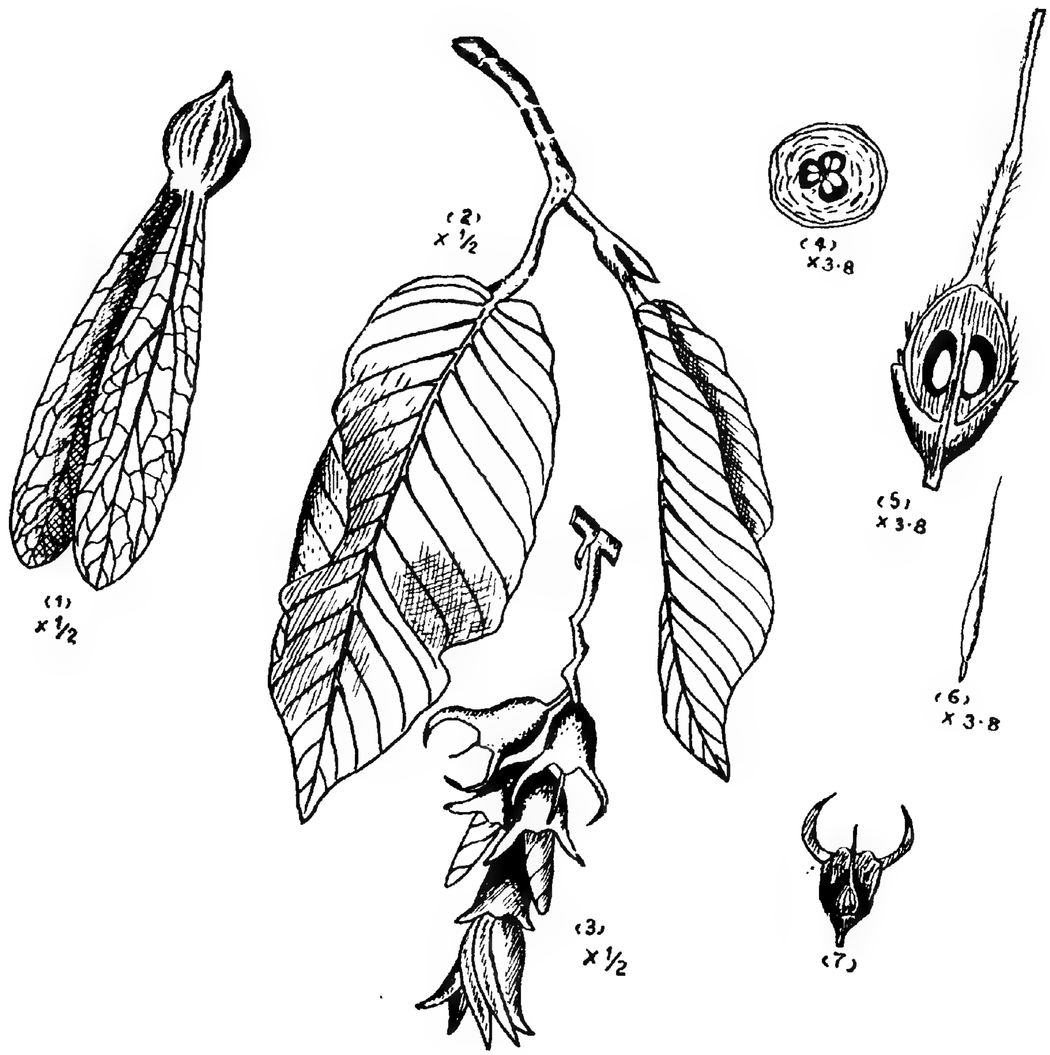
DIPTEROCARPUS PILOSUS.



1. Fruit. 2. Flowering twig. 3. Flower bud. 4. Flower. 5. Longitudinal section of flower with petals removed. 6. Transverse section of ovary 7. Longitudinal section of ovary. 8. Stamen.

R. I. Macalpine.
19/12.

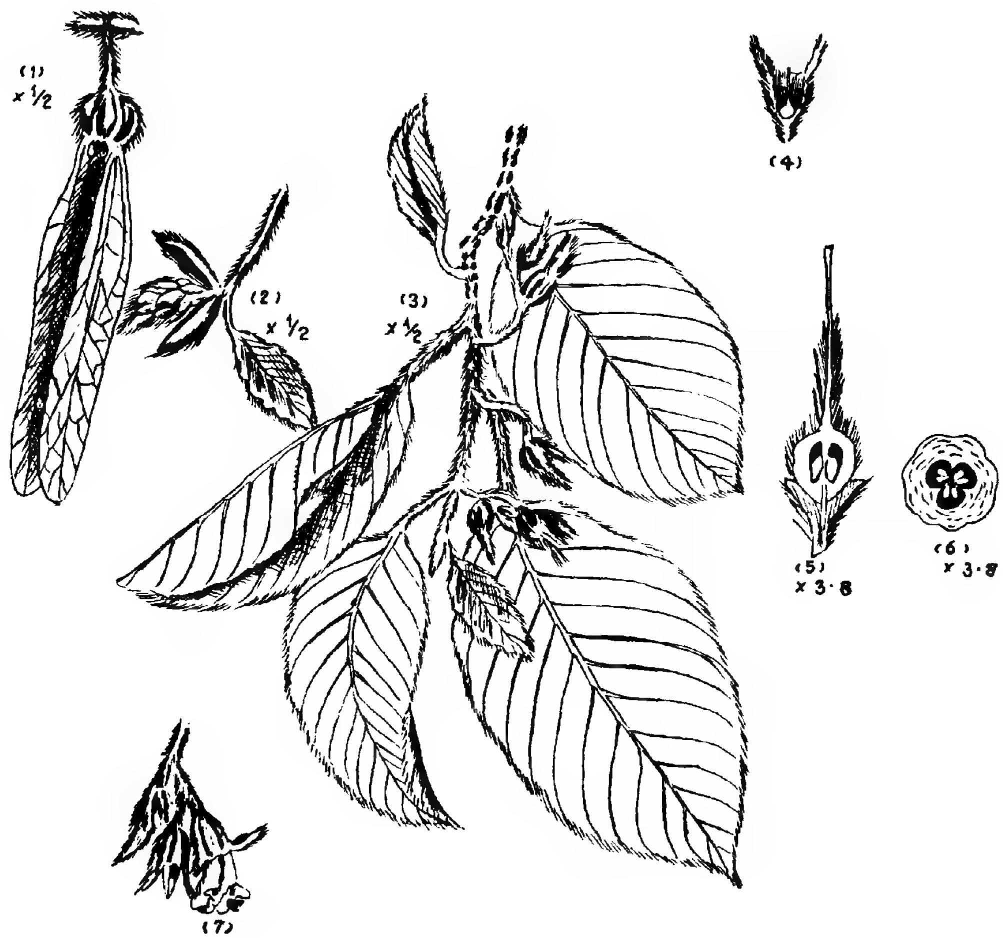
DIPTEROCARPUS TURBINATUS.



1. Fruit 2. Twig. 3. Raceme with opened and unopened flowers 4. Transverse section of ovary.
5. Longitudinal section of ovary. 6. Stamen. 7. Longitudinal section of flower with petals removed.

R. I. Macalpine.
19/12.

DIPTEROCARPUS COSTATUS.



1. Fruit. 2. Flower bud. 3. Flowering branch. 4. Longitudinal section through flower with petals removed. 5. Longitudinal section through ovary. 6. Transverse section through ovary. 7. Flowers, opened and unopened.

R. I. Macalpine.
19/12.

The time at which flowers and fruits appear are also of some assistance in identification.

Flowers	.. *D. alatus*	.. 1st half November.
	D. costatus	.. 1st half December.
	D. pilosus	.. 1st half December.
	D. turbinatus	.. End of December or beginning of January.
Fruits	.. *D. alatus*	.. End of February to middle of May. Apparently ripe fruits are also found as early as January but these are invariably insect attacked and have probably fallen as a result of this.
	D. costatus	.. End of March to middle of May. Insect attacked fruits are also found as early as February.
	D. pilosus	.. First week of May to end of first week of June.
	D. turbinatus	.. Middle of May to middle of June.

My thanks are due to Mr. Laurie and his staff for the trouble taken by them to reproduce the drawings illustrating this article.

CASUARINA ROOT-NODULES.

BY R. N. PARKER, I.F.S., FOREST BOTANIST, F.R.I.

H. Chaudhri in Bull. Soc. Bot. de France, 1931, p. 447, has an article on the root-nodules of *Casuarina equisetifolia* in which he says that nodules are completely absent in the Punjab and in the United Provinces. He states that they are always present in *Casuarina* growing along the coastal sand dunes. From this he argues that the nodules are not necessary for the growth of *Casuarina* except on soils deficient in nitrogen. He has tried inoculating *Casuarina* with bacteria from *Medicago*, *Melilotus* and *Lathyrus* but failed to obtain successful results.

These conclusions are apparently based on failure to find nodules on trees growing in the Punjab and on pot plants. They are, I believe, incorrect. Looking for nodules on trees growing well I have found unprofitable and inconclusive. One may be fortunate and find nodules but failure to find them is no proof that they do not occur. I have found nodules on a vigorous specimen of *C. glauca* Sieb. and on one of *C. montana* Miq. both grown in Dehra Dun from seed and not inoculated deliberately. In the case of the *C. glauca* Sieb. I felt convinced from its vigorous growth that it had root-nodules but digging up roots and carefully examining them on two occasions failed to show any. A few days after my second examination a root showing abundant nodules was exposed by weeding grass round the tree.

In 1913-14 there were a considerable number of *Casuarina* plants about 5 or 6 years old in the grounds of the Circuit House, Dehra Dun. I remember speculating on the reason for their poor growth without coming to any satisfactory conclusion, mainly because a single old tree was growing well in another part of Dehra Dun which showed that *Casuarina* will thrive in Dehra.

Casuarina planted in the grounds of the Forest Research Institute have given very uneven results. We have specimens of *C. equisetifolia*, *cunninghamiana*, *glauca* and *montana* growing well and others of the same species growing badly. Mr. Blake has recently been experimenting with *C. equisetifolia* grown in sand with and without root-nodules. His plants without nodules were very similar in appearance to those

we have doing badly, consequently when his experiments were closed down sand from his pots in which the *Casuarina* had nodules was used to inoculate the soil in an area where we have 8 specimens of 3 (or possibly 4) species of *Casuarina* all growing very badly. These plants though 5-8 years old were not over 8 feet high, yellow and sickly looking with many dead twigs. The soil around these plants was inoculated in August. Four months later root-nodules were found on one of the plants without much looking for. As soon as a nodule was found no further examination was made so that only one or two of the plants were examined.

At the time of writing 3 out of the 8 plants show a marked and very sudden improvement. There has been an abrupt change from the sickly yellowish foliage to a deep luscious green with thicker branchlets. Some of the other plants seem also to have improved but in their case the improvement has been much more gradual and one cannot be certain yet whether it is more than the normal spring growth.

It should be noted that the above 8 plants appeared to be growing satisfactorily during the first 2 or 3 years. One of them, which I conclude had no root-nodules since it has shown a sudden and marked improvement since being supplied with the nodule-forming bacteria, is at 5 years from seed 7 feet high and 1½ inch diameter at the base. A specimen from the same batch of plants which became naturally infected is 21 feet high and 4 inch diameter at the base. From this it appears that root-nodules are necessary for the *satisfactory* growth of *Casuarina* on ordinary agricultural soil in Dehra Dun.

As regards the organism that infects *Casuarina* one may assume, in the absence of evidence to the contrary, that one strain infects all species of the genus. As *Casuarinas* do not necessarily become infected in Dehra Dun it is evidently not one of the ordinary strain of bacteria that produce root-nodules on leguminous plants. Chaudhri's failure with bacteria from *Medicago*, *Melilotus* and *Lathyrus* is, therefore, natural. There are 12 known strains of bacteria that produce nodules on leguminous plants and I have suspected that the failure or unsatisfactory growth of several exotic leguminous plants in Dehra is due to absence of suitable bacteria. We have now two imported strains of

bacteria one of which is only known to form nodules on a single species (*Leucæna glauca*); the other is now being tested with *Casuarina* and the *Casuarina* organism is being tried with some leguminous plants that appear to fail to find the strain they require. One or two species have behaved in Dehra Dun very much in the way *Casuarina* does and it will be interesting to see if the same bacterial strain is the cause.

It seems probable that many more plants than are known at present have nodules and similar structures on their roots to enable them to obtain supplies of nitrogenous compounds. A promising field for investigation is the tropical evergreen forest where competition for nitrogen must be acute. In addition to the *Leguminosæ* the following are said to have root structures produced by nitrogen-fixing bacteria of the *Pseudomonas radicicola* type :—

Cycadaceæ; all species are said to produce "coralloid roots" concerned with nitrogen supplies.

Podocarpus and allied genera. Small nodules occur on *Podocarpus* roots in the forests in South Africa and I have seen similar structure on *P. gracilior* cultivated in Dehra.

Alnus is well known to produce root-nodules in Europe and *Alnus nitida* has large nodules in Dehra Dun.

Casuarina. I have seen nodules on the roots of 3 species.

Ceanothus (*Rhamnaceæ*).

Elæagnus and allied genera.

Myrica. As far as I know nodules have not been observed on species other than *M. gale*.

In conclusion it should be noted that the function of the nodules and similar structure in the above plants is not beyond dispute in all cases. The subject presents considerable difficulties as some nodules are doubtless due to parasitic attacks and the degree of dependence of the plant on symbiotic bacteria varies. Experiments made over a short period with plants in pots are likely to give results that cannot be altogether relied upon whereas experiments with trees in the soil are difficult to control. Root-nodules may not be necessary for the growth of a plant in a flower pot but they may be essential for its satisfactory growth in the field.

METHODS OF DISTINGUISHING BETWEEN IN AND KANYIN TIMBERS.

BY L. N. SEAMAN, OFFICER IN CHARGE, TIMBER TESTING SECTION, F. R. I.

The necessity for some simple means of identifying *in* and *kanyin* timbers has long been felt. In 1916 a note appeared in the *Indian Forester* on the "Differentiation of *In* and *Kanyin*. . . . ." relating to efforts which had been made to devise some kind of simple test, easily applied in the field, by which the wood of *in* (*Dipterocarpus tuberculatus*, Roxb.) could be distinguished from that of *kanyin*, a group of species of the same genus, including *D. alatus*, Roxb., *D. costatus*, Gærtn., *D. turbinatus*, Gærtn. f., and others. It was thought at that time that the woods could be separated, (*a*) by observing the exudation of oleo-resin when small blocks were heated, and (*b*) by observing the colour of the liquid obtained by treating with a 10 per cent. solution of potassium ferricyanide water in which shavings had been boiled. The specimens dealt with in that note were all reported under vernacular names, and it is now impossible to allot some of them to definite species; the naming of some specimens appears to have been in doubt even at the time, and the total number of samples studied was apparently too small to justify the deduction of general conclusions. The investigation, however, and the report constituted a step in the right direction, and served as a starting point for further research.

It appeared from reports then available that, heated to a temperature of 120° to 160° C. for about fifteen minutes, *in* samples would exude appreciable quantities of oleo-resin, while little if any such exudation would appear on the *kanyins*. The material to be examined was prepared in the form of small blocks having end surfaces clean cut to leave the pores open. Some of the analyses seemed to support this view, but in one case at least there was no important difference between the per cent. oleo-resin content of *in* and *kanyin*. Efforts to check this method were hampered by the difficulty of obtaining numerous samples of the various species properly authenticated.

In 1928, while attempting to check this method, it occurred to the writer that the appearance of the ash from burned splinters of the different species might be as distinctive as the differences in the quantities of the exudations. A trial seemed to give very promising results, but, as was the case in 1916, the number of authentic samples available was too small to justify the assumption that the results were conclusive.

Recently a fresh lot of authentic samples supplied by the Forest Economist, Burma, has made possible a further check of these methods. The material available comprised :—

10 samples of *D. turbinatus*, Gærtn. f.

15 samples of *D. tuberculatus*, Roxb.

19 samples of *D. alatus*, Roxb.

A block was cut from each sample and each block was given a distinguishing number, but no mark from which its identity could be guessed. An attempt was then made to identify the samples (*a*) by heating the blocks as described, and (*b*) by burning a splinter about the size of a match splint, cut from each block and observing the ash.

The method of heating the blocks and observing the exudation, while it showed that the tendency to produce a pronounced exudation was stronger with *in* than with *kanyin*, did not prove to be a satisfactory means of separating the two. When the reports based on exudation were referred back to the lists showing the species of each block it was found that the results were as follows :—

Species.	Correct.	Incorrect.	% Correct.
D. turbinatus ..	5	5	50%
D. tuberculatus ..	11	4	73%
D. alatus ..	13	6	68%

The method of burning splinters of the wood gave better results, except in the case of *D. turbinatus*, which it was found impossible to separate by this method also. The results were as follows :—

Species.	Correct.	Incorrect.	% Correct.
D. turbinatus ..	5	5	50%
D. tuberculatus ..	15	0	100%
D. alatus ..	15	4	79%

These results indicated that, by observation of the ash of burned splinters, a much better separation of the wood of *D. tuberculatus* from that of *D. alatus* can be made than by any means hitherto attempted, but that the wood *D. turbinatus* cannot be separated from either of the other two species by this method. As a further check, therefore, numbered samples of *D. tuberculatus* and *D. alatus* were submitted to two independent observers with a brief outline of the method. Though these observers had not heard of the method before their first attempts its application produced the following results :—

Observer.	Species.	Correct.	Incorrect.	%Correct.
A.	*D. tuberculatus* ..	12	3	80%
	D. alatus ..	19	0	100%
B.	*D. tuberculatus* ..	15	0	100%
	D. alatus ..	15	4	79%

On second trial all identifications were correct, but admittedly any observer, when he knows the solution, is apt to have his judgment subconsciously influenced by that knowledge. The essential fact,

therefore, is that, without any possible bias due to knowledge of the identity of the specimens and with no previous experience of the method it was possible to separate the samples of *D. tuberculatus* and *D. alatus* much more accurately and with much more certainty than by any other means so far tried.

The separation of these two species by this method depends on the appearance of the ash when small slivers of the wood are burned. Slender strips, about the size of match splints are cut, ignited, and allowed to burn out completely. The splinter must be held in the air till it burns out and ceases to glow. If it is laid down it will be extinguished by the cold surface which it touches and the nature of the ash completely concealed by a quantity of unconsumed carbon.

The ash left by the *D. alatus* is very small in quantity and extremely fragile, usually incapable of sustaining its own weight. It is often of a light brownish colour with a somewhat streaky appearance, but is sometimes nearly white. The ash of the *D. tuberculatus* is decidedly more plentiful and much firmer and stronger than that of the *D. alatus*. It is generally of a bluish white, or blue-grey colour. By first burning a few splinters of known specimens one can become acquainted with these differences, after which, with a little practice it should be possible to separate these two species with a confidence that the separation will be more than 80 per cent. correct. Indeed, with practice, it is thought the separation will be nearly if not quite perfect. It is unfortunate that the ash of *D. turbinatus* treated in this way resembles sometimes that of *D. tuberculatus* and sometimes that of *D. alatus*, and that the observation of oleo-resin exudations from heated blocks also fails to separate the wood of *D. turbinatus* as well as that of *D. alatus* from *in*. The matter is still under study and other possible methods of identification are being investigated in the hope of finding a means which, either by itself or in conjunction with the method described above, will serve to distinguish easily between *in* and *kanyin*.

CONTROL MEASURES FOR THE PROTECTION OF THE REGENERATION OF PINUS LONGIFOLIA.

By K. S. Allah Bakhsh, I.F.S.

INTRODUCTION.

There is no difficulty in obtaining regeneration in Rawalpindi Division as seedlings come up profusely every 4 or 5 years. Protection is the main problem, as the seedlings stand no chance of survival with cattle roaming about day in and day out.

The villagers consider the young seedlings their enemies, as once they are established they will prevent the growth of grass for years so they take every opportunity to destroy them. They set fire to the area. They cut grass and along with it the seedlings.

The villagers particularly resort to regeneration areas for grass cutting as such areas contain the largest quantity of grass which grows profusely under an open canopy and continues to do so year after year until the crop smothers it with the closing of the canopy.

It may be argued that *chil* crops do become established some time and why bother about them.

Chil seedlings have abundant powers of coppicing and they finally succeed in establishing themselves but only after a persistent struggle. If given the protection needed the plant will establish itself much more rapidly and will reach maturity within a reasonable rotation.

On the other hand repeated failure of regeneration through incendiarism will prolong the establishment of regeneration beyond one period and instances are not wanting where certain compartments have been placed in P. B. I. over and over again on this account. In many instances well established pole crops have been ruined and the work of decades has been undone. Prolongation of the period of regeneration necessarily means a prolonged rotation and consequent larger over-head charges and high costs per acre which cannot be allowed in the case of a cheap commodity like *chil* which brings only small profits. The compartment history files of the Rawalpindi East Forest Division show that fully regenerated P. B. I. areas have been ruined over and over again by fire.

Since departmental burning was introduced in 1915 in this district the extent of fires has decreased but this refers to areas other than P. B. I. areas, as no regeneration areas have been burnt under a definite programme. In the meantime the regeneration areas have suffered badly and for want of a definite programme they were very seriously damaged during 1921-22 and 1926-27.

With such a regular programme there will be less need of retaining two seed bearers per acre (*vide* para. 42·1 of the Rawalpindi East Working Plan) after the area is fully regenerated. This was needed in the past as regeneration was not fired until about 25 to 30 years of age.

If departmental burning is carried out on the right lines in regeneration areas it will be unnecessary to have elaborate fire lines, or to have any fire guards; departmental burning of all P. B. I. areas would save all this expenditure, and punitive closures would become unnecessary.

It is easy to protect a young regeneration area after it is burnt departmentally for the first time as subsequent burning every other year during winter presents no difficulty.

Departmental burning of young sapling crops carried out by me in 1930 gave me a great surprise. When I visited the area two to three weeks afterwards all the needles had turned yellow and I felt that a great mistake had been made, but immediately after the break of the rains the area looked very healthy as if nothing had happened. The net gain was that the area was safe against damage by incendiary fires for the next two years.

BURNING IN P. B. II. AREAS.—I would advocate that the controlled burning of young crops should also be extended to P. B. II. areas exactly on similar lines so that as much as possible of the natural regeneration present in P. B. II. areas is saved, thus complete regeneration of P. B. I. areas within a shorter period could be ensured.

The triennial fires ordinarily prescribed for the other periodic blocks and systematically carried out have frustrated all efforts of nature to regenerate the areas and any seedlings that have come up after good seed years have been destroyed. Such regeneration was

retained under the Selection System. Many of the P. B. II. areas contain beautiful seedlings which would be destroyed at the next triennial burning and the area would thus not get the start it used to get under Selection System. There is equally good reason to extend this method to areas containing seedlings in the Unregulated Working Circles which if not protected by departmental burning will be lost one day and the areas will remain in that circle for ever.

TYPE OF DAMAGE IN *Chil* REGENERATION AREAS AND ITS TREATMENT.

The following types of damage are the common causes of failure of P. B. I. areas :—

BROWSING.—Browsing damage is generally high above the ground and is commonly confined to the tips of new shoots. Nibbling by the teeth of browsing animals is distinctly recognizable.

GRASS CUTTING.—Damage by grass cutting is nearer the ground and a more or less clean cross cut is apparent.

FIRE.—It is not difficult to distinguish fresh damage by fire ; old fire damage can generally be distinguished in seedlings by a number of shoots coming from the same height above ground and the leading shoot is missing.

The treatment necessary for the protection of *chil* regeneration will therefore consist of—

(*i*) restricted grazing and grass cutting and fencing against cattle where necessary.

(*ii*) keeping the regeneration areas clear of slash, fire protecting the seedling crops, cleaning the sapling crops and winter burning of the whole area excepting seedlings.

GRASS CUTTING.

Villagers will cut *chil* seedlings along with grass even when they are visible except when the compactness of the stand and the thickness of the stems is such that it is more convenient not to cut them. Again there is a tendency to cut seedlings and saplings in Protected Forests

where they have rights so that the supply of grass is not interfered with. It is therefore clear that grass cutting is injurious in *chil* crops until the plants are 2′—3′ in height.

SEASONS OF GRASS CUTTING.—Villagers need cut grass for stall feeding the milch cattle thoughout the year and for winter feeding other cattle. The supplies of grass from their fields are always reserved for the winter.

In March and April green grass is cut along with dry grass for daily requirements. All grass dries up in May and June and is usually covered with *chil* needles which fall during these months and if it is cut during this period it is mixed up with dry needles and therefore is not relished by cattle. In July and August grass cutting is done only to meet daily requirements. In September and October it is cut for winter storage as well as for daily requirements. No grass cutting is done in December and January.

Even with the object of reducing inflammable material grass cutting must not be allowed within the regeneration areas in the months of September and October. To save the lengthy procedure of obtaining Government orders for suspension of grass cutting rights, it should be possible to close all regeneration areas in Protected Forests against grass cutting under Working Plan sanction immediately after such areas are placed in P. B. I. and the allotment to periods should be organised accordingly. It is necessary that regeneration areas should be so well distributed over the district that villagers have always some area available for grass cutting near their homes.

Grass cutting in regeneration areas must be absolutely prohibited until the young seedlings are clearly visible in the grass and until the stems are too thick to be cut along with the grass; in other words grass cutting must be strictly prohibited until the crop is about 2′ in height. It would be better to exclude grass cutting entirely from P. B. I. areas and to reduce the quantity of grass by permitting restricted grazing. If, however, there is scarcity of grass and the villagers undertake to save the seedlings, grass cutting may be allowed in young crops over 2′ in height but this must be done only under strict control.

GRAZING.

Chil seedlings are much damaged by cattle by browsing the juicy tips and by trampling and up-rooting the young seedlings. As the cattle move down the slopes, seedlings are pulled up between their feet. The extent of damage varies with the season, *i.e.*, the cattle do less damage by browsing when there is plenty of edible grass immediately after the monsoon is over. The damage is greater during the winter months and greatest during the early summer. After the grasses have shed their seed they have little nutritive value. The cattle will seldom eat it and during the winter and early summer the cattle prefer the green leaves of trees and other green stuff on the ground including tips of young *chil* seedlings.

The damage to *chil* seedlings is greater during seasons of fodder shortage, dry years, on dry aspects, along migratory routes and in the vicinity of cultivation and habitations. It is considerable in close proximity to villages, and areas at low elevations suffer more than higher areas. It becomes still greater where pasture lands are limited and the number of cattle is excessive.

The following experiment shows what a large number of cattle will do in a short time :—

In October 1930 6 cows and 4 buffaloes were permitted to graze over half an acre in a P. B. I. area (Compartment 24 (*i*). At 9 in the morning before the cattle were let in, the area contained 1,700 seedlings. At 5 p.m. the same day there were only 1,450 seedlings undamaged, the tops of 15 seedlings were missing and 30 seedlings apparently uprooted by the cattle were picked up from the ground ; the remaining 117 seedlings had been eaten up entirely. The age of the seedlings varied from 1 to 3 years.

The malformation commonly found among young crops although partly due to fires is to a very great extent due to browsing and trampling. It is rarely due to bad soil. As however absolute closure to grazing will cause a profuse growth of grass among the seedlings it will be advisable to open such areas to grazing for a month or so immediately after the monsoon, say from 15th September until the

quantity of grass is considerably reduced, then close the area for the rest of the year.

There is no harm in permitting grazing in young *chil* crops which have been departmentally burnt, as they have passed the grazing damage stage. Grazing in seedling crops for a short time after the monsoon will reduce the grass and controlled grazing of limited numbers and for a limited number of days may be permitted. Closure restricted to the rainy season helps to produce more grass and only indirectly helps the regeneration. We must therefore protect the seedlings against browsing during the winter and before the rains and let the cattle graze for a few weeks immediately after the rains.

FENCING.

CLOSURES.—I advocate closures against continuous grazing as I have seen concrete instances where as a result of closures to grazing since 1928, as in Compartment 24 (*i*), all the old badly grazed plants are putting on shoots and both natural and artificial regeneration is flourishing.

It is hardly fair to the surrounding population to declare an area closed and take no steps to keep out the cattle. The cattle will certainly stray in the closed area close to the village or on the way to water or to other pasture lands. Occasional seizure by the Beat Guard does not mean very much. At the most he apprehends one out of 10 cases of trespass and that is no protection as the harm continues and such a closure does not meet the end required. It is therefore imperative that the closures must be effective and it is obligatory on the department to fence the area wherever necessary. In the case of small areas (30 to 50 acres) there must be a fence all round but in the case of bigger areas fences may be erected only where there is danger of cattle straying into the regeneration area.

TYPE OF FENCING.—Ordinarily closure against grazing if effectively carried out will only be needed for about 5 to 7 years by which time the crop will have become established. *Chil* poles will be available locally and no other expensive type of fencing is needed for this purpose.

If the lower ends of the posts are charred they will last longer. The posts are buried 2′ deep and 10′ to 12′ apart and only two horizontal poles nailed to them. The lower horizontal pole should be 20″ above ground and the distance between the two horizontal poles should be 12″. This type of fencing is quite cheap as all the poles required will be available locally and iron nails do not cost much.

If *chil* seedlings are protected against grazing and grass cutting they will grow to a height of about 3′ in 5—7 years after which the area can be opened to grazing and grass cutting. Such an effective procedure will considerably mitigate the villagers' troubles which naturally increase with long closures.

CLEANING.

The term cleaning is a misnomer as it correctly denotes removal of inferior species. Early thinning is the more correct term. But the term cleaning is now standardised and is well understood. The underlying idea in cleaning is to open out the saplings only to such an extent as will prevent their catching fire from one another when a departmental fire is run though the area.

SPACING.—It has been found in actual practice that 3′ spacing of saplings of 3′ to 6′ in height fulfils this object. 3′ spacing has been adopted provisionally but wider spacing will do no harm. Increased spacing has other advantages. Fire hazard is considerably reduced and the growth of saplings is accelerated. The extent of the patch taken up for cleaning must be determined beforehand. If this is not done the labour is likely to throw out stems about indiscriminately, thinking that they are putting them outside the patch.

METHOD OF CLEANING.—Cleaning work should never be left to a labourer or to an ordinary Forest Guard although an intelligent Forest Guard will pick up the work soon and do it well. All malformed and suppressed saplings can be cut out to start with over a small area. The Forester then goes over the area with a 3′ stick and roughly spacing the best plants with the stick directs the labour to take out the rest. One Forester can control 3 to 4 men on cleaning work and a cleaning gang should not consist of a larger number of hands. Intelligent coolies

take to this work in a couple of days and such men should be invariably employed in preference to others. No tall seedlings standing under saplings should be left as they very often carry fire into the lower branches of the saplings.

As the cleaning work proceeds the Forester should look out for any old logs and have them removed to open places and heaped there. If refuse burning has not been carried out after the last felling, a complete gang of six will have to be employed for dragging out logs.

REMOVAL OF UNDERGROWTH.—All shrubs standing close to saplings should be cut out but it would be waste of money to cut out groups of brushwood with no saplings nearby. If the brushwood is dense with saplings here and there, it is better to leave such patches unburnt within the burnt area. Where old stumps are found among the saplings it is cheaper to take out plants standing near the stumps than to take out the stumps.

All cut stems should be thrown out into gaps and built into small heaps for burning. Cut material should not be allowed to lie scattered in the cleaned area under any circumstances. Very often open spaces full of seedlings are selected by ignorant labourers for the purpose. Ordinarily if the heaps are kept small, small gaps among the saplings can be found for the purpose.

DAMAGE THROUGH GRASS GROWING AMONG SAPLING CROPS.—Grass helps in burning the lower branches of saplings but it does not do much damage beyond scorching the needles. In any case it does not kill the plants in a properly cleaned stand. It has been observed that even after the grass is grazed between the plants, grass standing close to them sends the fire up the stems but this again does not do much damage unless a local gust of wind creates a conflagration. Sometimes dry needles hanging at the axils of branches act in the same way.

TIME OF CLEANING.—Cleaning can be carried out at any time during the year but the best time is shortly before the winter rains. Late cleaning tends to leave lower branches alive for a longer time thus increasing the size of knots and delaying the first thinning. It is necessary to carry out the first silvicultural thinning when stems are clear

of branches to a height of 40′. If cleaning is done late the first thinning will be delayed beyond the above stage and the trees will not put on the required girth within the rotation.

Advantages of Cleaning.—As congestion will be reduced the crop will be more vigorous and less liable to disease. Root competition will be considerably reduced. Lastly as a result of cleaning there will be little suppressed stuff. As soon as the lower branches are dead and the canopy has re-formed there will be less grass on the ground and apart from the annual leaf-fall there will be little combustible material in the form of undergrowth. Departmental burning will become an easy affair and the crop will thus be automatically protected against summer fires.

CONTROLLED WINTER BURNING IN P. B. I. AREAS.

Slash Disposal.—After fellings are over in P. B. I., part of the refuse wood is removed by the right-holders in Protected Forests and the villagers can be encouraged to take what they like in Reserved Forests. It has often happened that the villagers do not avail themselves freely of such refuse in Reserved Forests as they think it an offence and very often Forest Guards are to be blamed for this. They should therefore be informed by a responsible official that they can take what they want. Whenever a forest area is conveniently situated part of the refuse can be sold for conversion into charcoal for which there is always some demand. What is left after this is done has to be disposed of otherwise. (See slash burning.)

After clearing round the tapped trees and other seed-bearers, all slash (logs and branch wood) should be heaped and a fire run through the area in sections separated by natural boundaries such as *nallas* and ridges. The heaps will catch fire and will be partly burnt. If they are not green they can be finished off with very little labour in a couple of days. Sometimes green slash (logs in particular) will not burn but they can be left in heaps till they are dry. So long as they have been heaped away from the trees and a surface fire has been run through the area they will not be a source of danger. If however a

good seed-fall is expected the following spring it is better to finish them off at once at a little extra expense.

SEEDLING CROPS.—Seedling crops represent 1 to 5 year old plants. If fire and grazing damage is not heavy the seedlings should attain a height of about 2′ to 3′ in 5 years. In the seedling stage the stems and the bark are thin, and even a controlled winter fire may kill the seedlings outright, though young *chil* seedlings have a wonderful power of coppicing. If however the seedling is killed back year after year the resulting coppice will never develop into a good tree. It is therefore considered essential to fire protect the seedlings until they have developed a thick bark which being a bad conductor of heat protects the seedlings against fire.

In actual practice it has been found that in plants about 2′ high the bark is thick enough to withstand a surface fire, provided they are so thinned out that in case one of the plants catches fire it does not pass it on to the next through contact. This means that fire protection of *chil* during the seedling stage is an absolute necessity but as it passes on to the sapling stage and is able to stand a ground fire it should be burnt every other year after once cleaning it. Burning of slash among young seedlings is a very hazardous affair requiring very great precaution. A line must be burnt round every heap and every precaution taken that the fire does not get out of control.

SAPLING CROPS 3′—6′.—The smallest size and lowest age at which a *chil* plant can stand a ground winter fire determines the time of the first controlled burning. The main test is the condition of the bark ; if it is rough and thick it is fit to stand a slow winter fire.

Burning may be carried out from the sixth year onward provided the plants have put on normal growth and the bark is of normal roughness and thickness. As however it is very seldom that the seedlings remain undamaged by browsing and fire during the first 5 years it is essential that the height of the plant and condition of the bark rather than the age of the crop, may be taken as a guide for first burning.

BURNING OF LEAF LAYER.—Sometimes it will be difficult to run a surface fire among saplings even during the driest season due to want

Fig. 1. *Chil* sapling crop average height 2 ft., cleaned to 2 ft. apart and burnt during winter.

Fig 2. 3 ft.- 6 ft. *chil* sapling crop cleaned to 3 ft. apart and burnt during winter.

Photos by author.

of sufficient leaf layer on the ground. Such patches may be left out of account. If the season and ground is too wet the surface fire will just touch the top of the leaf layer. Such burning is of little use as the main cause of damage is not removed. Generally the fire burns only the top leaf layer and does no more than scorch the lower compact layer. An up-hill fire (winter) only scorches the top leaves leaving a thicker layer of unburnt leaves than does a down-hill fire.

SAPLING CROPS 7′ AND OVER.—It has been found in actual practice that sapling crops 7′ and over can be fired departmentally during winter a few days after rain, without carrying out cleaning, as the crowns are far above the reach of a surface fire. It is however first essential to drag out any thick wood and slash and dispose of it in the open. All dead and dying saplings must be removed. If however all crops 3′—6′ are cleaned as a matter of routine there will be no question of giving such areas any special treatment.

TIME OF BURNING OF SAPLING CROPS.—Cleaning can be carried out at any time during the year before the winter rains but it is necessary to burn the same year, because if left to the next year the crowns will close up. The best time for burning saplings is a few days after winter rain. The cut stuff will also be dry by this time and it will catch fire and burn easily.

The exact time for controlled firing after cleaning will have to be determined by the man on the spot. In case of doubt the best course will be to burn a small patch and if a fire can be made without damage to the saplings the work can be continued. If however it has become too dry the next rain may be awaited : the main point is to catch the right time. Sometimes it would be difficult to run a fire even before the winter rains on wet northern aspects. In such cases a warmer time will have to be found before or after the winter rains. A good deal of picking and choosing will have to be done to finish an area during winter. Wet *nallas* on northern aspects containing broad-leaved species and much undergrowth are seldom likely to be burnt even during summer so they may be left alone.

TREATMENT OF SAPLINGS MIXED WITH THICK UNDERGROWTH.—When regeneration is found among undergrowth, not much can be done as, if it is fired, all regeneration will be lost and if the undergrowth is cut the expense will be very high. The only course is to leave such areas and if necessary burn round them. If however undergrowth contains no regeneration it will be better to cut a line round the patch and burn it at a season when it can be burnt clean.

TREATMENT OF MIXED PATCHES OF SEEDLINGS AND SAPLINGS.—If seedlings are mixed with saplings, the determining factor for burning or fire protecting depends on whether the future crop will consist of existing saplings or seedlings. In the former case it can be burnt and in the latter protected. After close observation of the area it is always possible to settle the point one way or the other.

DAMAGE TO LOWER BRANCHES IN SAPLINGS.—It will sometimes happen that controlled burning will kill the lower branches to a considerable height. This will not usually happen if burning is carried out down-hill and at the right time. However if it does happen, this should not cause alarm, as we want to get rid of the lower branches as early as possible and so long as the leader and some of the top shoots are not killed, the plant will put on new leaves and will be better protected in later years as there will be no lower leaves to carry up the fire.

HEAVY LEAF-FALL AFTER FIRST BURNING OF SAPLINGS.—After the first burning in sapling crops, a good many of the lower branches are badly scorched and there is a considerable fall of needles to the ground. This is so particularly where there is much grass or undergrowth which increases the intensity of fire and consequently the intensity of leaf-fall. In such cases it is necessary to burn the area in the following year and every other year after that.

BURNING OF POLE WOODS IN P. B. I. AREAS.—Burning is best done from 1st November to 15th December before the first winter rains when the temperature is low and the leaf layer is dry. Burning after the rains often does not burn the leaf layer completely. The fire merely passes over and burns the upper layer leaving the lower layer partially scorched. Burning of a small amount of

Fig. 3. *Chil* sapling crop over 6 ft. in height, burnt before winter rains without previous cleaning.

Fig. 4. *Chil* sapling crop, average height 6 ft., cleaned to 4 ft.—5 ft. apart previous to burning.

Photos by author.

scattered branch wood is generally unnecessary. If a large amount of slash is present it must be dealt with in the ordinary way.

SEED BEARERS.—Those that are being tapped must be cleaned or burnt round before departmental burning is undertaken and under no circumstances should the channels be allowed to catch fire. Burning round is more expensive but it is the surest way to protect a tapped tree. Resin found near the base must be scraped and burnt clean. Ordinary chips scattered about need not be collected as they will be automatically burnt with the surface fire but where such chips lie close to a tree they must be removed to a safe distance but need not be heaped and burnt separately.

AFTER CARE.—As seedling patches will be left unburnt after care is a very important consideration as, if the fire passes out of the burnt patches from smouldering heaps, it will do considerable damage to such protected patches.

TECHNIQUE OF SLASH BURNING.

DEBRIS BURNING AFTER SEEDING FELLING.—This should not present many difficulties as there will be little regeneration on the ground to be saved and beyond saving seed bearers by removing debris to a distance of 10′—15′ and cleaning any patches of young growth very little else will be required. After this is done the area can be fired without any further collection of debris.

UNDERGROWTH AND GRASS.—When a P. B. I. area is burnt for the first time after a seeding felling all undergrowth must be burnt except in wet *nallahs* where a mixture of broad-leaved species is required. After seeding fellings it is advisable to postpone burning of debris in blanks to the autumn preceding a good seed-fall, as a clean burnt area is likely to be invaded by dense grass and weed growth. But such patches as contain regeneration in the shape of seedlings and saplings must be cleared of debris at once. This procedure is advantageous as debris burns easier after it is 1 to 2 years old. Debris collection and burning will be more difficult after a secondary felling as much labour will be required in heaping and burning to save seedlings and established regeneration.

A heavy first seeding felling will therefore go a long way in reducing future debris burning. If the seeding felling has been light and good regeneration has come up by the next intermediate felling, much loss of seedings and saplings is inevitable as the heaps of debris will be heavy and much scattered.

LABOUR ORGANIZATION.—In order to keep down costs it is necessary to organise and direct labour systematically otherwise slash burning will be very expensive. The most economical working unit is a gang of six who work together when big size slash is to be handled, and split into two gangs of three each when small size logs are to be dealt with. The supervising Forester must direct operations, and not leave it to the labour as they will waste much time and the outturn of work will be small. The Forester will decide when the gangmen are required to work together and when to split in two parties.

A gang of six men should have at least three levers, each 8′ long and three axes. Levers must be carried by particular men otherwise they will be left behind. Strong men should be named as lever men. In firing fresh debris long branches with leaves are helpful.

It is well known that town fires always draw large crowds as there is very great temptation to stand and watch a burning fire. Except in the case of firing heaps of fresh debris for the first time which require 3 to 4 men, not more than 1 or 2 men are allowed to fire the heaps. For the same reason heaping gangs should have nothing to do with firing. When burning heaps of old debris there should be only one fire-man whose duty will be to follow up the heaping gangs and light the slash heaps if the two jobs are done simultaneously. He should occasionally walk back to see that the heaps are burning properly and give any attention required. He is strictly forbidden to stand by a heap to watch it burning. It usually takes more than one day to finish up the logs in a heap and the fire-man will have to go round occasionally and look to each heap over again but each one of the heaps need not be attended to more than twice or thrice a day.

SUPERVISING STAFF.—One Forest Guard should be detailed purely on supervising and directing the fire-men, who should be kept constantly on the move. Much labour can be wasted if heaping is not directed by a man who understands his job. Ordinarily no official below a Forester should be put in charge of a heaping gang.

HEAPING DRILL.—Heaping must ordinarily be done as soon after intermediate and final fellings as possible so that in case of a summer fire the damage is localized. In the case of a seeding felling this may be delayed but a space round seed bearers must be cleared at once. To keep down the intensity of heat very big heaps should be avoided. At the same time they should not be so small as to make it difficult to burn thick logs. In order to keep down expenses it is necessary that as little cutting as possible should be done and the use of the axe should only be resorted to when there is no other alternative. Ordinarily the best method is to have at least three to four logs collected together as they will help one another to burn.

In blanks debris may be fired without collection in the first instance as the fire burns part of the debris, then collect together what is left; this way will be less expensive.

Again in order to save expense logs should not be dragged over long distances. It will also keep down the size of heaps if smaller logs are dragged down to the nearest big logs and piled all along their lengths. Small logs should not be burnt by themselves, because if this is done there will be nothing to burn the big logs. Dragging should always be done down-hill and as far as possible at right angles to the contour. Rolling should never be allowed as rolling logs get out of control and are likely to injure young plants and particularly sapling crops. Rolling logs however do less damage to very young seedlings.

CHOICE OF HEAPING SITES.—There should be no difficulty in choosing a site for a heap if there is no young growth near by. Heaps must be at least 10′ away from seed bearers and sapling crops. Sometimes this is difficult to arrange; in the case of a big patch of established regeneration heap at the nearest open places, and if necessary sacrifice some saplings by cutting round the heap.

In case of seedling crops it is very expensive to pull out all the logs from a big seedling patch ; it is better to pile a heap within the patch lengthwise by heaping several logs together parallel to each other. This however cannot be allowed among sapling crops : logs must be pulled out to the nearest open place and burnt there. Pulling logs at right angles to the contour with the help of levers, if well directed, does little damage to the saplings. Sometimes the shape of the log and the nature of the site will not allow this ; in that case a log can be cut in two or three pieces and dragged out. In guiding the log down-hill with the help of the levers, the work will become easy if the heavier side is kept downwards. In that case 2 levers at the butt end and one at the tail end will conveniently guide the log down to the side of the heap. Where long thick branches create difficulty in the movement of a log down-hill, only the obstructing branches should be cut. Unnecessary cutting of branches should be avoided to keep down expense.

There will be rare instances when the size of a log and the absence of open sites close by will make it difficult to move the log out of the sapling crops. In such cases the only alternative is to cut saplings on either side of the log say to a distance of 5′ on either side and burn the log *in situ* gradually by heaping small quantities of chips upon it. There is no harm in throwing logs into *nallahs* where no regeneration is expected. They need not be burnt as they will rot in the course of time.

CHIPS AND BARK.—Chips resulting from felling refuse are generally collected in concentrated heaps. Such heaps must be removed to a safe distance from saplings. After the first ground fire most of the stuff on the ground is burnt, the leaf layer is much reduced, scattered chips and pieces of branches left out do not easily catch fire and so do not help in increasing the intensity of heat. Such chips will rot in a year or so and it is unnecessary to collect them.

TIME OF BURNING HEAPED DEBRIS.—Heaps lying in blanks or among seedlings burn better during the dry season before winter rains. Heaps lying in or near sapling patches should be burnt when the temperature

is low and heaps are not wet. No burning should be done when a breeze is blowing.

METHOD OF LIGHTING HEAPS.—Coolies are apt to use pine needles in carrying fire from one heap to another. This is a very dangerous and inefficient method. Long pieces of torch wood should be used as no fire will be dropped and no time will be wasted in lighting a series of heaps. The following procedure works satisfactorily :—

A coolie takes a lighted torch from one heap to the other and lights a fire at one point only. He then places about half a dozen cones at this point and as soon as the fire is lighted he takes the burning torch to the next heap and does the same thing there. Leaving his torch there he returns in a few minutes to the last heap, picks up the cones which have caught fire and distributes them over several points on either side of the heap and returns to the next heap to carry on the process further. In this manner a lot of time and expense can be saved.

The heaps are allowed to burn out and they are not to be attended until the fire is about to go out. It should be borne in mind that fire and time will finish up the slash in due course and any effort to expedite the burning means waste of labour and money. All that is needed is to move the logs close together when the fire is likely to go out. In this way one man can control a very large number of heaps. It needs much less labour to heap more debris on a partially burnt log than to cut it to pieces. However cutting may be allowed as a last resort when no debris is available and the log will not burn otherwise. All heaps should be lit down-hill and against the wind.

SEQUENCE OF BURNING.—In order to avoid fire spreading from the heaps into the forest the following sequence is desirable :—

Unless a ground fire has been run during the previous year a short time before heaping it is better to pile the heaps over a section and then run a ground fire over that section. Most of the heaps will catch fire and burn out. Where *chil* seedlings are to be fire protected no ground fire is permissible. In such cases individual heaps must be burnt by clearing a line round them so that fire does not spread.

Thick slash should be burnt before chips are burnt as it is very difficult to complete burning of partially burnt logs which need small stuff to fire them and if all chips have been burnt beforehand it is very difficult to finish of. Burning slash however is not so easy immediately after felling and heaps may be allowed to lie until the following winter. But it will be safer to fire the fresh heaps once before summer so that all small wood and needles are burnt.

CLEARING ROUND HEAPS OF FRESH DEBRIS.—Clearing must be done round heaps of fresh debris by burning a line round the heaps. The line should vary from 5′—10′ on the up-hill side of the heap to 3′—5′ on the down-hill side. This will not be necessary if a ground fire has already been run.

In firing heaps of fresh debris lying close to saplings as much of the ground as necessary can be safely burnt round the heap before firing the heap, so that the saplings will be required to stand heat from the heap alone and not the heat of the ground fire as well.

SUMMARY.

The above observations may be summed up as below :—

(*a*) Restrict the litter over as small an area as possible at the time of felling.

(*b*) Remove as much of the slash as possible through right-holders and others.

(*c*) Arrange disposal of useless trunks scattered in P. B. I. areas by permitting charcoal burning on payment or otherwise.

(*d*) Collect and burn all remaining stuff at convenient places and away from established regeneration.

(*e*) Burn all pole crops before the winter rains.

(*f*) Fire protect all seedlings below 3′ in height.

(*g*) Clean sapling crops from 3′—6′ so that a fire can be run without doing damage.

(*h*) Burn all sapling crops a couple of days after winter rainfall.

(*i*) Repeat the controlled burning operations regularly every other year.

(*j*) Close to grazing all young regeneration and fence it where necessary (permitting controlled grazing for a few weeks after monsoon).

(*k*) Exclude all grass cutters from P. B. I. areas and in particular from seedling crops and take action to suspend rights of grass cutting if any.

PRESERVATION OF NOTEWORTHY TREES.

BY H. G. CHAMPION, I. F. S.

Since my note on the subject of the preservation of noteworthy trees and samples of forest types, I have received a communication from the Punjab detailing the action taken in the matter there and in the North West Frontier Province. It makes exceedingly good reading, especially just now, when more than ever, the year's budget and surplus (or deficit!) tends to be the first consideration.

In the Punjab, thirty exceptional deodar have been thus protected for their natural term of life, including magnificent specimens up to 164′ high or 38 feet girth, as well as a wonderful *deota* tree shewn as 20 feet diameter with an average crown spread of 110 feet. The trees are distributed over four divisions. *Chir* pine has also not been forgotten, for a tree 9′ 8″ in girth in Rawalpindi East Division has been added. Better still, ten plots covering types with *Pinus excelsa*, *Abies*, *Picea*, *Cedrus* and *Populus euphratica* have been selected for preservation, acreage varying from 1½ to 250 acres.

In the North West Frontier Province similarly, eighteen deodar, twelve blue pine, five silver fir, two spruce and five walnut have been selected as well as a plot of *Quercus semecarpifolia*.

Congratulations to those responsible, and may their action long be remembered to their credit !

RAMNAGAR REGENERATION FELLINGS.

BY W. A. BAILEY, I. F. S.

In the article "Paget, M. P., Looks at Sal," in the May 1932 number of the *Indian Forester* there are one or two remarks on which I consider it necessary to comment. I may say that owing to the tours of those set in authority over us I regret it was impossible for me to meet "R. M. G." on his recent tour in the Ramnagar Forest Division. I hope, had I been able to do so, that it would have been possible to explain to him more accurately what has actually been done in this division.

R. M. G. says, "To take the example of Ramnagar Division, a typical *dun* valley formation, the earlier attempts at heavy seeding fellings produced a quite presentable show of regeneration mostly from coppice but in subsequent years, from 1924 onwards, the deadly combination of deer browsing, frost and fire plus the repeated cutting back of all advance growth to obtain 'regularity' in the young crop has resulted in a dismal regularity of failure." To my mind any one reading this who was not acquainted with the actual facts, would imagine that heavy seeding fellings were made irrespective of the state of the regeneration that existed at the time, that no attention whatever was paid to the advance growth that existed, and possibly also that the "quite presentable show of regeneration mostly from coppice" came rather as a surprise to the officer who made the heavy seeding felling. Further he might imagine that as this regeneration came up from 1924 onwards it was repeatedly cut back because it was not regular.

R. M. G. has confused two entirely different operations. Where adequate established regeneration existed no seed fellings of any kind were made. What was actually done is that in such areas a heavy felling was made to open up the area, retaining only a light shelter of well spaced standards. In the year following the felling the existing regeneration (advance growth) was all cut back once and for all; there has been no repeated cutting back. The necessity for this cutting back was that the advance growth was not only irregular and badly shaped but that much of it had been badly damaged in various ways and if kept as a future crop would have produced unsound misshapen trees.

Seeding fellings were made in areas that had inadequate or unestablished regeneration. Such fellings were only made over a very small area. I have recently had occasion to enumerate the trees in the area in which the heaviest seeding felling of all was made. The seed bearers left average 25 per acre and are all fine big trees. This was the first seeding felling made and is very much heavier than any that have been made since. There is no doubt however that these seeding fellings have failed to produce the results that were expected a few years ago.

R. M. G. also enquires why the Forest Department cannot regulate the incidence of *shikar* activities so that the deer do not get so completely out of hand as to become a first class forest pest. It is easy to be wise after the event. The first areas dealt with on the retention of a light shelter wood *cum* cutting back basis were extremely successful and now contain as good a sapling crop as you could want to see anywhere. It had always been taken almost as an axiom that deer and cattle do not eat *sal* ; such damage as has occurred during the last few years was hitherto entirely unknown.

I may say in conclusion that in the Ramnagar Division no markings either for seeding fellings or "cutting back" fellings have been made for the last two years and it is extremely unlikely that any more will be made in the near future.

SIR ALEXANDER RODGER'S NEW APPOINTMENT.

We have very great pleasure in copying the following paragraph from the home papers :—

The King has approved the appointment as a member of the Forestry Commission of Sir Alexander Rodger, late Inspector-General of Forests to the Government of India.

Every member of our service will unite in congratulating Sir Alexander on this appointment, for we all know how much he deserves this honour. We also feel that the Indian Forest Service, as a service, shares the reflected glory, for although the Forestry Commission has now been in being since 1919, this is the first occasion on which any forester without long experience in home forestry has been put on the Commission.

REVIEWS.

The Himalayan Journal. Vol. IV, April, 1932.

The fourth number of the Himalayan Club's magazine has more than maintained the excellent standard set by its predecessors, both in quality and in volume, and can be recommended to all forest officers who take any professional pride in the pioneering side of our work. Few of us, of course, have the chances which come to professional surveyors, explorers and mountaineers of exploring and reporting upon virgin country, but forest work takes us into many strange and little known corners, and the pleasures of such touring are undoubtedly increased if we have been in the habit of cultivating the geographer's outlook. One need not be an expert geologist or mapmaker, but a slight knowledge of these and the other sciences which assist the pioneer will all help to develop " the eye for country " which is such an asset to the traveller, whether he is on military reconnaissance, forest working plans, forest exploitation schemes, or merely on a *shikar* trip.

Apart from the accounts of the spectacular attacks on giants such as Kamet and Kangchenjunga, there are several records of mountain journeys such as are feasible for the ordinary mortal in Kashmir, Lahaul, Bashahr, Garhwal, Kumaon, Sikkim, Lhonak, and the less accessible though none the less fascinating forest country of the North East. The only botanical note is a review of Sir Aurel Stein's researches on the ancient mountain plants used in Zoroastrian and Rigvedic ritual, of which *Ephedra* appears to have been the principal. There are, however, numerous references to plants and animals in most of the contributions, for mountaineering is rapidly broadening from a mere display of brute force into a study of everything which goes to make up the fascinating interplay of Nature at high altitudes.

R. M. G.

REPORT OF THE FOREST PRODUCTS RESEARCH BOARD FOR 1930.

The centralisation of the various sections of the Forest Products Research Laboratory at Princes Risborough from their previous scattered quarters in Oxford and London has already borne fruit in increased efficiency, and the requests for the services of the laboratory by the wood-using trades are increasing rapidly, showing that the institution is fulfilling a felt want.

There is now a separate section dealing with Timber Physics which has already done much to justify its existence in the work it has done on the "collapse" of certain timbers independent of insect or fungal attack. "Though attempts have been made to explain, in terms of capillary action, the way in which water is held in wood below the fibre-saturation point, the results have not been very successful and it seems probable that absorption of water by the wood-substance itself is also involved in order to account for the decreased vapour pressure of the water held in wood. In fact, it seems evident that the colloidal nature of wood substance is of importance in explaining many of the properties of wood in bulk. Instances of this may be found in the "collapse" of wood during seasoning and its subsequent reconditioning, in the plasticity of wood at high degrees of temperature and moisture content, in the volumetric changes accompanying dehydration below the fibre saturation point, and in the hysteresis cycles found in moisture equilibrium conditions." And yet some people have the temerity to pretend that they know all about timber and to say that timber research is an unnecessary luxury!

The question of proper seasoning naturally takes a prominent place in the report and an interesting development is the revision of existing specifications for building timber as used by the home building trades. Hitherto the general method of seasoning has been to stack sawn timber for a considerable time before using it, the periods varying with the dimensions and species as found by experience. Generally no determination of the moisture content is made,

and the degree of dryness is judged by such vague methods as touch, appearance, or weight, or simply from the time it has stood in the stack, the latter being generally used as a specification by contracting parties. With the variations caused by the time of year the seasoning is begun or the timber used, local climatic changes, the initial condition of the wood, and the varying methods of piling and protecting the stacks, it is obvious that this specification is of little real value. It is obvious that the moisture content affords a more certain means of defining the condition of timber, and the specifications recommended by the Laboratory are :—

Timber for :	Moistre content not to exceed :
General carpenter's work	.. 25 per cent.
High-class carpenters' work	.. 20 per cent.
General joinery work	.. 15 per cent.
Best joinery, block and strip flooring, panelling and decorative work	.. 9 to 12 per cent. for centrally heated rooms. 10 to 14 for rooms and buildings not centrally heated.

The moisture content can easily be found from the weight of a small specimen taken from the stack and the weight of the same specimen after being dried in an oven.

A considerable amount of important work on wood-destroying beetles and fungi is recorded and it is shown that preliminary experiments have been made in the use of X-rays to detect insects in wood. Experiments have revealed in some cases quite small larvæ in wood half an inch thick, which would not otherwise have been found without breaking the wood into fragments. To investigate and suggest means of checking the damage done by lyctus powder-post beetles in the hardwood trade, a survey has been made of all the important timber centres in the country. The general interest of the trade in this matter has been aroused, and in a number of cases manufacturers and merchants are known to be applying successfully the

methods suggested for sterilising the timber and restricting the spread of the lyctus beetle.

Attention is drawn to the speedy progress of the work on Empire timbers being carried out by the Department, with the financial support of the Empire Marketing Board. "The increase of general public interest in Empire timbers and of the use of such timbers, not only in Government but also in public and private buildings, has been particularly evident during the past year, and is testimony to the joint work of the Empire Marketing Board and this Department." The report, however, stresses the fact that the effectiveness of the work will be impaired unless adequate machinery exists to deal with production and marketing as well as research. "Apart from measures to be taken by the timber trade to develop more extensive commercial dealings in Empire timbers, there is a lack of adequate official machinery for dealing with difficulties in the producing areas and concerning production generally, more especially in certain of the tropical regions."

R. M. G.

FOREST ADMINISTRATION REPORT FOR BALUCHISTAN, 1930-31.

Planting work in the extremely arid climate of the North-Western Frontier must always be an uphill task, and it says much for the keenness of the small forest staff in Baluchistan that so much has been accomplished. The main activity is nursery work, and the nurseries serve the double purpose of supplying transplants for the small reserved forests and distributing fruit and shade trees amongst the local cultivators and military officers. The report gives a long list of such distributions, but the local names used occasionally leave the reader somewhat vague as to what the plants are, *e.g.*, "heaven tree," "horse radish tree" and "Persian pine," to say nothing of a string of vernacular names. The favourites appear to be willow cuttings, *Pistacia*, ash, *chinar*, *Robinia*, deodar, cypress, almond and rose bushes, and it is inevitable that such work should savour more of market gardening than of forestry.

An unusually dry summer and a shortage of the previous winter's snowfall led to many casualties in planted areas and an almost total failure of direct sowings in the reserved forests, except in the case of a few riverain areas of *Tamarix*.

The revenue depends largely upon the firewood supplies to Quetta, Fort Sandeman, and the other smaller frontier cantonments. In spite of the increasing competition from coal imported to such out-of-the-way places, it is satisfactory that the revenue has been maintained. One interesting item is of over Rs. 3,000 for *Ephedra*, for which a royalty of Rs. 2 per maund is charged.

R. M. G.

FOREST ADMINISTRATION REPORT FOR CENTRAL PROVINCES, 1930-31.

Apart from a drop of Rs. 9 lakhs in the forest revenue which reduced the cash surplus to Rs. 8·7 lakhs, the main features of the year were the civil disobedience activities and an enquiry into forest grievances. That the department has stood a severe test is shown by quoting from the Government Resolution : " The civil disobedience movement in the form of forest *satyagraha* entailed a heavy strain upon all ranks of the department, and Government wishes to congratulate its officers on their excellent handling of the situation. A particular word of praise is due to the Forest Rangers, Range Assistants, and Forest Guards. The latter were often exposed to boycott or violence in their lonely *nakas*, but not one deserted his post. This is a fine record of which the department justly may feel proud."

Just how much of the drop in revenue is due to this civil disobedience rather than to the general trade depression it is difficult to say, but the combination of the two has had a rather devastating effect. One example is the reduction of 34,760 acres of felling *coupes* worked in the various types of working circle. Another is the drop of over Rs. 2½ lakhs in the value of minor produce such as bamboos, lac, grass, and *rusa*-grass oil ; only *harra* (*Terminalia chebula*

nuts) showed an increase, and this was due to an opportune departmental effort to handle surplus stocks which had been left unsold through failure to place the usual contracts.

In view of complaints made in the Legislative Council, a committee was appointed to enquire into forest grievances, especially grazing. It began in March 1929 and was dissolved in August 1930 owing to the resignation of most of the non-official members before its work was completed, – from which one may gather that the local politicians' enthusiasm for fault-finding waned when they began to appreciate a few of the forest officers' difficulties! In spite of its early demise, the enquiry has done considerable good in bringing to light many minor inconveniences and has helped to bring forest officers into closer touch with the altering needs of the villagers. As the Government Resolution says: "Though these grievances may be trivial in themselves it would be unwise to rest under any illusion as to their cumulative effect on the general contentment of the people, and the work of the department must be judged as much by its success in reconciling local needs with the demands of forest conservancy as by the commercial results which it achieves." Unfortunately Government itself is a little apt to forget this perfectly sound viewpoint when it comes round again to its Budget session each year!

In meeting legitimate grievances, a number of amendments were issued to existing working plans and settlements where the arrangements were not suitable. The reason given for such changes being necessary is that owing to the shortage of officers, grazing settlements are no longer prepared by sufficiently experienced I. C. S. officers. In some cases it is the order of felling which bars certain villages from access to grazing or water. In others restrictions were applied before the owners had been given an opportunity to arrange for grazing elsewhere. The question of selecting inferior forests for regular working under coppice when the area would have been more suitable as permanent pasture also comes in; in such areas the restrictions on grazing should be more with a view to preserving the land as pasture rather than for the production of a mediocre forest

crop of fuel or poles. Better co-operation between the Forest and Agriculture Departments is essential if this widespread problem is to be solved on a broad and sound scientific basis.

The report is very outspoken on the subject of the provincial silviculture. It states that the prescriptions of recent plans are all for conversion to uniform, but that unless the area contains an unusual amount of advance growth and can be properly fire-protected —a difficult and chancy business with such a prolonged dry season as the Central Provinces generally experience,—it is doubtful whether this system is suitable for the majority of the forests unless controlled grazing can be used to keep the grass down. Regeneration by coppice is also disappointing. And finally: "no methods for inducing regeneration have as yet been discovered, and once the areas containing advance growth are exhausted, the uniform system is doomed to failure." Then why go on with it?

The operations against *Lantana* were continued vigorously in Melghat. "There is now a regular programme. The *Lantana* is burnt in two successive hot weathers and after the second burning eradication is commenced in the rains. According to the results obtained the burning in the third year is done either early or late." The great difficulty is to keep the fire under control, as once the *Lantana* is well alight it is apt to develop into a regular tree fire.

An interesting point in connection with game control is the organising of beats on a large scale in which the large number of 688 pig were accounted for. In one instance a local land-owner was given *carte blanche* to destroy game in a small isolated reserve adjoining his property, and as a result of several beats which reduced the number of pig, chital and nilgai, it is now possible to grow ground-nuts where previously every kind of crop was destroyed.

An interesting development in Allapilli was the use of a fleet of motor lorries to carry timber a distance of 62 miles from the sawmill to Ballarshah sale depôt. This allowed for the marketing of a much larger quantity than could have been handled by bullock-carts; the work was done by a contractor at a flat rate of 6 annas per cubic

foot, and marks a real advance in transport methods. The Allapilli sawmill itself showed a greatly increased profit and a slightly increased output. It is now working at full capacity and is quite unable to handle all the material offered, —a very enviable condition for any departmental venture in these gloomy days!

R. M. G.

FOREST ADMINISTRATION REPORT FOR THE UNITED PROVINCES, 1930-31.

The financial position of the Forest Department in the United Provinces has not suffered as seriously as in some of the poorer provinces in the present trade depression. Although their gross revenue has fallen from Rs. 61·74 lakhs in 1929-30 to Rs. 49·70 lakhs in 1930-31, and the surplus from Rs. 28·55 lakhs to Rs. 17·70 lakhs, the existence of several well-established subsidiary industries such as resin, paper, and match-making has acted as a buffer to soften the effect of the fall in timber values. The year was, however, an anxious one, for apart from financial worries and the vital need for economy, the political situation might easily have led to widespread boycotting of forest work and disobedience of forest laws. " The annual auctions in the rains of 1930 required the most tactful handling. They commenced in the Eastern Circle when the prices of grain were starting to fall and the timber market was very slack. As they progressed in this Circle and later in the Western Circle economic conditions rapidly became worse. Such conditions naturally lent themselves to efforts on the part of contractors to keep down the sale prices of lots by combination and other means. After the first few divisional auctions picketing by Congress volunteers commenced and continued with considerable vigour until the last two auctions, from which picketing was entirely absent." Many sale lots were left unsold due to the combined effects of commercial stagnation and political interference.

Apart from the trouble actually instigated by politicians, there was a marked increase in incendiarism in the Kumaon foothills, which gives a clear indication of the feeling of unrest and lowered respect for

law and order which have been brought into being by persistent anti-Government propaganda. The burning of hill forests in a dry year is so easy and the results so spectacular that it is one of the first ways in which any general feeling of unrest manifests inself: as we are again at the beginning of another fire season which owing to the general failure of winter rains is full of horrid potentialities, it is to be hoped that the somewhat stronger line since taken by the authorities will have discouraged the mischief-makers. In Kumaon one deputy ranger died as a result of injuries received in fire-fighting, and several subordinates had to take medical leave, so it is obvious that the Chief Conservator's appreciation and praise of the work of the executive staff has been thoroughly earned.

Under silvicultural headings no change is reported in natural regeneration work except an extension of the concentrated working of coniferous forests brought in by the revision of the Garhwal working plan. As regards the natural regeneration of *sal*, it is reported that game-proof fences are of definite value for areas already stocked with whippy *sal* seedlings which without this extra protection cannot get ahead. There is certainly no doubt that unrestricted browsing can completely destroy a young coppice crop in places where deer have been allowed to get out of hand. Unfortunately fencing alone does not bring regeneration in of its own accord, and fencing is only of value where there is already a young crop struggling on the ground.

In addition to the very successful work at Gorakhpur, *taungya* has now been started at several other centres, namely the Bhinga and Motipur forests of Bahraich, Tulsipur in Gonda, Jaspur in Haldwani, and Pathri and Baniawala in Saharanpur, but the difficulties of labour and climate have so far prevented any *taungya* beginnings in the main blocks of Haldwani and Ramnagar, where regeneration is most backward and where regular plantation work is restricted to very small areas.

Work in the Afforestation Division is unfortunately to be reduced as an economy, but as the area now stocked amounts to over 16,000 acres there is much maintenance work to be done, while the valuable

advisory and supervisory work connected with private estates in Etawah district will fortunately be continued. The formation of *panchayat* forests in Kumaon is still in the critical initial stage which is dependent on the personal influence of the Panchayat Forest Officer. The danger of the heavy lopping of oak forests has already been fully demonstrated in the case of the Murree Hills in the Punjab, and it is hoped that better protection may be effected in Kumaon by handing over the oak areas to *panchayats*, beginning with the Adwani and Ameli blocks. Rules for the formation and management of *panchayat* forests are now being brought into force, establishing their legal position, but as the Chief Conservator rightly points out, popular management of this sort can expand only if it meets with non-official support and enthusiasm.

The grazing data show an apparent decrease of over 3 per cent. in the total of animals of all kinds grazed, but after seeing some of the enormous herds of lean and hungry cattle which roam through these forests, particularly in the more densely populated foothills, it is difficult to believe that there has been any real reduction. This is borne out by an analysis which shows that the reduction of the head of cattle is entirely under those on payment. The usual methods of checking the numbers allowed free grazing are so rough that only a provincial cattle census can be relied upon to show the true position.

Sal continues to be the mainstay of the provincial revenue, as is clearly shown by the figure of Rs. 16½ lakhs as the value of *sal* railway sleepers, while of the total output of sawn timber 63·7 per cent. is *sal*. But the demand for other species is slowly increasing and timber other than *sal* now amounts to 21½ lakhs cubic feet. Out of this 11½ lakhs is of *chir* pine, 2½ is of *sain* (*Terminalia tomentosa*), 1½ of *Dalbergia sissoo*, 1 of *haldu* (*Adina cordifolia*), and 1 of *semal* (*Bombax malabaricum*). The development of the local match industry absorbs the last named and its price works out to about Rs. 18 per *semal* tree. Further developments in other woods can be anticipated, because the Forest Research Institute has been working on supplies of oak for parquet flooring, *Terminalia chebula* and *belerica* for seasoning tests, spruce and silver fir for preservative treatment, deodar for

half-round and quarter-round sleepers, and "pintar" extracted from twisted *chir* wood for road-making. The Wood Working Institute at Bareilly has also been testing *Pterospermum acerifolium* for umbrella handles (for which there must be an unlimited market in India!), *Mallotus philippinensis* for walking sticks, and various other woods for the pencil industry. A great field still lies undeveloped, however, and much more might be done to develop the local use of 'inferior' timbers. The Bengal foresters are seriously discussing whether *sal* is not a dying timber. Quite apart from any question of its silviculture, many of them believe that its place as a structural timber will be gradually usurped by concrete and metals. In their damp climate this is already happening to an alarming extent, and the sale of the larger sizes of *sal* beams and scantlings for city buildings is already moribund. In the drier climate of the United Provinces timber ought to hold its own better, and the cultivators and *zamindars* who are the forests' best customers are unlikely to give up using *sal* for their structural work, nevertheless the possibility of such slow but sweeping changes in market requirements should not be lost sight of.

In view of the imminent closing down of the Haldwani Division tramway, a comparison of the financial results of the two forest tramways now working in the province is interesting. Current costs for the year work out at 1·67 annas per cubic foot for Haldwani as against only ·25 annas for Gorakhpur, the plains conditions and a shorter lead in Gorakhpur making for much cheaper working. The profits in each case work out at 1·77 and 1·03 annas per cubic foot, but as a percentage on the total capital and maintenance costs up-to-date, these profits work out at 12·5 per cent. for Haldwani and only 7·6 per cent. for Gorakhpur, showing how the heavier capital cost of the latter installation, (Rs. 3·51 lakhs as compared with Rs. 2·23 lakhs for Haldwani), remains as a heavy handicap throughout its life.

R. M. G.

EXTRACT.

THE ZOOLOGICAL SURVEY OF INDIA.

By Lieut.-Col. R. B. SEYMOUR SEWELL, I.M.S., Director, Zoological Survey of India.

In the year 1784 the Asiatic Society of Bengal or, as it was then called the Asiatic Society, was founded by Sir William Jones. The formation of a Museum was not definitely stated to be one of the objects of the Society, but specimens were frequently sent to the Society, either for examination and report or for safe custody, and in 1796 a definite proposal for the erection of a suitable building, to house the collections that had thus accrued, was first mooted. It was, however, not until 1808 that the Society came to possess its own building, which it still occupies to-day, but from then on definite efforts were made to establish a Museum and this was finally achieved in 1814.

Although Sir William Jones, the founder, was opposed to the collection of zoological objects, on the ground that it entailed the destruction of life, there was, nevertheless, from the very inception of the Museum a quite definite biological bias. At the outset the Museum was sub-divided into two parts, (*a*) comprising archæology, ethnology, and technical exhibits, and (*b*) including geology and zoology. The former section was placed under the care of the Society's librarian, and the latter under a special curator, the first to be appointed being Dr. Nathaniel Wallich, who presented to the Museum duplicate specimens from his own collection in order to form a nucleus.

Up to 1836 the Museum was supported entirely from the funds of the Society, but in that year, owing to financial troubles and losses, consequent on one of the Calcutta banks closing its doors, the Society was compelled to petition the East India Company for assistance in maintaining the Museum and the necessary staff, and in 1839 the Company sanctioned a grant of Rs. 300 per mensem for this purpose. The first curator to be appointed under the changed conditions was Dr. J.T. Pearson of the Bengal Medical Srervice, thus commencing the close association between the Museum and the Government medical services that has continued to the present time. The continual growth of the collections in due time again caused a strain on the Society's resources, and in 1856 the Government of India was petitioned to found an Imperial Museum for India ; the outbreak of the Indian Mutiny caused matters to be postponed for a few years, but in 1862 the Government announced its intention of founding such a Museum in Calcutta, and by the Indian Museum Act of 1866 definitely provided for its establishment and created a Board of Trustees for its management. The actual construction of the building naturally took some time, and it was not until 1875 that the Museum was ready for occupation, and the first two galleries, namely, those of archæology and the mammalia, were thrown open to the public in 1878.

A study of the records of the Society shows that during these early years a number of distinguished zoologists had contributed to the collections, and among these one may perhaps mention Dr. J. Anderson, who had made two collecting expeditions into Yunnan and China, in 1868 and 1875, and later became the first curator of the Indian

Museum. Various other collections came from regions so far apart as Abyssinia, Persia, Tibet, different parts of India, Assam, and Burma ; and in addition the Society received very valuable collections that had been made during the Persian Boundary Commission (1870-72), the second Yarkand Mission (1873-74), and the Dafla Expedition (1874-75). All these collections were handed over by the Asiatic Society to the Indian Museum to form the nucleus of the zoological collections.

The next stage in the evolution of the Zoological Survey of India may be said to have begun in 1875 with the opening of the Indian Museum as a State museum, and the appointment of a permanent staff, entirely maintained by funds provided by the Government of India. During the preceding few years the Asiatic Society had been taking a very keen interest in the schemes that were being put forward in other parts of the world for the investigation of the deep-sea fauna, and it felt that India should also play its part in these investigations : the Government was at this time considering the formation of a Marine Survey of India, and in consequence of the representations made by the Society it determined to appoint to this survey a special officer, the surgeon-naturalist, whose duty it would be to carry on investigations on the Indian deep-sea fauna, at the same time ruling that the collections thus made should be the property of the Asiatic Society of Bengal and, after identification, should be incorporated in the collections of the Indian Museum. The first appointment to the post of surgeon-naturalist to the Marine Survey of India was made in 1875, and in 1881 the Royal Indian Marine Survey ship *Investigator* was launched.

At its inception the Indian Museum included sections dealing with zoology, geology, and archæology, and it was not until twelve years later, in 1887, that the section of art and economics was added. From the very commencement the importance of the zoological section was clearly recognised, and this is shown by the fact that the first three appointments to the staff were given to zoologists, namely : curator of the Indian Museum, Dr. J. Anderson ; assistant curator, Mr. J. Wood-Nason ; and first assistant to the curator, Mr. G. Nevill. A few years later the surgeon-naturalist was given an unofficial status in the Museum by being appointed an honorary assistant. Thus, very soon after its inception, the Museum staff consisted of four zoologists.

With the creation of a permanent staff, and as a result of a breadth of vision and a true appreciation of the value of zoological research that has ever characterised the Trustees of the Indian Museum, it became a recognised part of the function of the staff to go out into the field and make their own collections, so as to make a study of the living, just as much as of the preserved, animals ; it was thus possible for a number of expeditions to be carried out in various parts of the Indian Empire and even beyond its frontiers, and among the latter regions that were visited, mention may be made of the expeditions by the late Dr. N. Annandale to the Lake of Tiberias in Palestine, to the Tale Sap in Siam, and to Lake Biwa in Japan. These activities naturally resulted in large accretions to the collections, and during this second period in the history of the Zoological Survey very considerable further additions were made by a succession of surgeon-naturalists on the R.I.M.S. *Investigator*, pre-eminent among whom stands Col. A. Alcock, I.M.S. During this period large additions of valuable collec-

tions of both the land and fresh-water fauna were obtained as the result of systematic collecting during certain political and military expeditions, notably during:

(1) The Afghan Delimitation Commission, 1885;
(2) The Afghan-Baluch Boundary Commission, 1896;
(3) The Tibet Expedition, 1903-4;
(4) The Seistan Arbitration Commission, 1903—6; and
(5) The Abor Expedition, 1911-12.

Numerous additions were also presented to the Museum by friends of the department, such as officers of the Geological and Botanical Surveys of India, the Indian Forest Service, and the Indian Medical Service; by planters in various parts of India; and finally, but by no means the least, by the officers of the Hoogli Pilot Service, to whom the Museum owes a very valuable collection of the fauna of the estuarine region at the mouth of the Ganges. Special mention must also be made of the collections made by the officers of the Fishery Department of the Government of Bengal and by the research trawler *Golden Crown* during investigation into the fishery resources of the Bay of Bengal.

Several very valuable collections, such as the de Niceville collection of butterflies, the Dudgeon collection, etc., were also purchased by the Trustees.

The rapid increase in the size of the collections, and the consequent work of the Zoological and Anthropological Section of the Museum, resulted in a gradual increase in the staff, and in 1916 there were four zoologists on the permanent staff of the Museum, and, in addition, attached to the Museum were one unofficial, though paid, worker, the late Mr. E. Brunetti, and the surgeon-naturalist—the total staff thus being six.

It was in this year, 1916, that the Zoological and Anthropological Section of the Indian Museum was converted by the Government of India into the Zoological Survey of India. The reason of this conversion is not to be found in any change in the duties of the officers of the department, but in the recognition by the Government that the work of the section had been and then was, in all essential features, similar to the work that was being done by the already existing Geological and Botanical Surveys, and the need of placing the head of the section on an equal footing with the directors of these other Surveys as a fellow-trustee of the Museum and not merely a paid servant of the Trustees.

The ever-increasing work of the Survey has from time to time necessitated the creation of additional appointments, and at the present day the full staff as sanctioned by the Secretary of State should consist of a director, two superintendents, and seven assistant-superintendents, the last addition to the staff being the naturalist to the Marine Survey, a post that was previously always held by an officer of the Indian Medical Service. Up to the present time, however, only seven officers have been appointed, and of these one is an anthropologist. In consequence of the policy of the Government of India to indianise the various services, as many Indians as possible have been selected to fill the various posts as they fell vacant or were sanctioned, and to-day the director is the only European in the Survey, the other six officers being Indian.

The conversion of the Zoological Section of the Museum to a Survey gave official recognition to the view that field-work was one of the most important duties of the department, and it thus became possible to formulate definite programmes of work that could be spread over a series of years. A commencement on definite survey lines had, however, been begun some years previously by investigations into the lake fauna of Asia, and this had culminated in the survey of the Chilka Lake, a special volume of the *Memoirs of the Indian Museum* being devoted to the results. The first definite survey of the newly created Zoological Survey was undertaken at the request of the medical authorities in India, who, as the War of 1914—18 drew to its close, become anxious lest the disease schistosomiasis, that was unknown in human being in India, though present in other animals, might be introduced by troops returning from areas overseas in which this disease is rampant. Systematic investigations were, therefore, undertaken in order to discover whether any of the known mollusc hosts of the Schistosome might be present in India, or, alternatively, whether any of the more common fresh-water molluscs could act as such a host; and, in addition, to determine what species of Cercariæ were already living in the country. As a result of these inquiries, the Zoological Survey was able to inform the Government that, so far as it was possible to judge, there was no fear of an extension of this disease into India, a conclusion that was entirely justified by results, for although the troops from overseas were brought back to India without any precautions whatsoever being taken in the way of quarantine, there has been no spread of this disease in that country.

Our knowledge of the fauna of India is still very incomplete, and in every case in which an officer of the Zoological Survey of India has taken up the study of a group in the animal kingdom it has proved to be necessary that he should first pay careful attention to the taxonomic side, in order to determine the various species that are present. As a result, considerable progress has been made on these lines, and during the sixteen years that the Survey has been in existence the number of new species that have been described and of 'types' that have been added to the collections of the Indian Museum has averaged some one hundred and twenty-five a year. Up to quite recent times the Survey has not attempted to deal with purely economic problems, unless specially requested to do so; it was rightly considered to be of more importance that their energies should be devoted to purely scientific research, for no zoological research can have any economic value unless it has a scientific basis, and the foundation of all such work is taxonomy. Nevertheless, the Survey has from time to time contributed towards the elucidation of problems of economic importance, and has been consulted by various local governments on such problems as the reorganisation of fishery departments, the institution of biological stations, the preservation of the fauna,—as, for example, the Monitor lizards that were being exterminated for the supply of skins for the leather market—oyster fisheries, or the control of various species of animals that were directly or indirectly destroying crops. Within the last two years the Survey has by circumstances been compelled to take up one problem of economic importance, namely, the maintenance and preservation of the *Trochus* and *Turbo* fisheries in the Andaman Islands.

For many years past, each officer has been encouraged to take up two lines of study—one taxonomic and the other general; they are thus brought into touch with some of the wider problems of zoology and are in a better position to take advantage of their opportunities for study in the field, while the department as a whole is in a sound position to undertake team-work and thus to tackle the investigation of any of the more general problems, on the solution of which so much may depend in a country like India, in which agriculture and public health are the two subjects of greatest importance.

The Zoological Survey of India publishes the results of its research work in two serials that are devoted to zoology, namely, the *Records* and *Memoirs of the Indian Museum*, and within the last year has commenced a third, entitled *Anthropological Bulletins from the Laboratory of the Zoological Survey of India*. These publications are very largely composed of original papers by the officers of the Survey, and by a system of exchanges with some three hundred other societies and institutions the Survey is able, with comparatively little cost, to maintain a very fairly complete and up-to-date library, that without any doubt is the finest zoological library for purposes of research in Asia. This library is at the service of every *bona fide* zoologist throughout the whole of India; a list is kept of all those who are engaged in research work, and every such worker is allowed to have from the library two volumes at a time for a period of a fortnight. In this way workers are able to keep in touch with and consult recent literature, without which it would be impossible for them to carry on their researches. Within the limits imposed on it by space, the Zoological Survey of India also provides accommodation for any research worker who wishes to come to the Museum in order to carry on his work either in the library or in the laboratory, and there is an ever-increasing demand for facilities of this nature, not only from zoologists in India but also from other countries.

It is no exaggeration to say that if the Zoological Survey is in the future to be curtailed, either in its personnel or its financial resources, to such an extent that the continuance of its publications is rendered impossible, such a blow will be dealt to the study of zoology in the whole of India that it will put the country back to where it was in 1875, when the Museum was first started, and will render almost impossible the satisfactory or trustworthy investigation of every problem in which zoology may be concerned. Finally, any drastic reduction of the staff must seriously endanger the collections. Such collections, specially in a tropical climate, require constant attention for their preservation and continuous study and research to maintain them in an up-to-date and scientific condition, so that each animal is correctly labelled and can at once be referred to for comparison and examination: and if in the future these collections are allowed to decay, the loss, not to India alone but to the whole world, will be one of the first magnitude.—(*Nature, April 9th*, 1932.)

OBITUARY NOTICE.

On the 11th May, at Mussoorie, Angela, the beloved wife of William Nagle, Forest Research Institute, Dehra Dun, after a long illness patiently borne.

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THE NEED FOR GAME PRESERVES.

Throughout the civilised world there is a strong feeling in favour of preserving wild animals, many of which are already very scarce. In many countries this has already borne fruit in the establishment of a series of game preserves or of national parks in which the game can find a sanctuary. The parks of the United States are already famous and draw visitors in their thousands to enjoy the scenery and the novelty of studying wild life. The African and Burmese parks and sanctuaries are not so well known but have already proved their value in saving some of the rarer game animals from extermination, while the Swiss national park in the Engadine has done the same for some of the European Alpine fauna. A recent development has been the increase of the Parc National Albert in the Belgian Congo from an original 60,000 acres to 500,000 acres, and a similar area of new ground has been demarcated to form the Parc Ruwenzori adjoining the British Uganda boundary, while other countries with a less spectacular wild life than the Congo can boast of are doing their bit, though on a less liberal scale, towards the preservation of their national fauna.

The chief defaulters at present appear to be Australia and India. Is the British Empire to prove as improvident of her wild animal life as it has been with its forest resources ? In India we have a Wild Birds and Animals Protection Act which looks all right on paper but which is in most parts of the country a complete failure. Outside our reserved forests all game of whatever sort will be exterminated in a very short time, and even within our reserves the few remaining rhino-

ceros in Bengal and Assam are being poached so ruthlessly for the value of their horns that complete extermination is inevitable unless something is done quickly. The harmless monitor lizard is falling a victim to the craze for lizard-skin footwear, and during the three years 1926-29 more than 7 million skins valuing Rs. 115 lakhs were exported from Calcutta. Now the smaller lizards are suffering in the same way.

Wholesale netting of most of the migratory birds is taking place around Calcutta and the other large towns of India and is playing havoc with these visitors, while there is little chance of saving any of the non-migratory birds which have the misfortune to be a marketable commodity. The interesting and attractive little musk-deer has already disappeared from the more populous hill tracts of the Western Himalayas, and even in the wilder districts is getting very scarce. Some years ago the forest staff in Bashahr got convictions against three villagers who had actually killed over 80 musk-deer in the course of one winter, but now that the shooting license arrangements have been removed from Government's hands there is not even a chance of obtaining a conviction against poachers.

Protective legislation appears therefore to be useless unless definite tracts of country can be marked out as sanctuaries, as has already been done so effectively in Burma and Africa. There is a Society for the Preservation of the Fauna of the Empire which carries out much useful propaganda in the home press, but which so far has directed most of its appeals to the Colonial Office. In this country some such society is badly needed, but until some body of unofficial opinion has developed, the whole onus of efficient protection falls upon the Forest Department, which is the recognised game warden of the country. There are still some tracts of country outside the reserved forests which contain an interesting fauna, and timely action by getting such areas notified by Government as temporary faunal reserves would help to preserve them. Where the existing game laws are obviously insufficient to prevent poaching within the boundaries of our reserved forests, and where the forests are the only possible sites for local faunal reserves, it is all the more necessary to have selected blocks of reserved forests notified as permanent game sanctuaries.

The formation of sanctuaries does not mean that harmful species are to be allowed to increase uncontrolled. The game wardens of such preserved areas must of course be allowed to keep down such obvious pests as the wild dog, and where less harmful animals such as deer increase disproportionately and cause loss to the local cultivators or to the forest itself, they must be kept in check by discriminative shooting. As an example of efficient protection we may quote the *oorial* of the Attock and Rawalpindi *rakh* jungles. Some thirty years ago the *oorial* herds were seriously reduced by heavy shooting, and there was hardly a single head of over 25″ to be had. Since then the shooting has been carefully governed according to the state of the herds, and to-day most license-holders can get a head of 30″ as a trophy. The Nilgiri ibex has been saved from extinction in the same way. It is however much more difficult to prevent the poaching of animals which are of definite commercial value, and it is in their interests that we advocate the absolute reservation of suitable sanctuaries on a larger scale than has yet been attempted in India, and much more stringent measures to enforce the existing laws against poachers.

The Indian lion has completely disappeared from the rest of India, but thanks to the protective measures enforced by Kathiawar State, it has been given sanctuary in Junagadh and has increased from a bare dozen to about a hundred. As the lion is practically extinct in Persia and elsewhere in Asia, this sanctuary is all the more important as being the last stronghold of the Asiatic lion. It is to be hoped that similar action will soon be taken by some of the Western India States to protect the wild ass, which has already been all but exterminated from Bikanir, Bahawalpur and Cutch, in each of which only an occasional specimen is to be found. Our chief appeal however is on behalf of the rhinoceros (both the one-horned *indicus* and the smaller two-horned *sumatrensis*) and the bison, for it is the larger beasts which breed slowly and are hard to hide which are most urgently in need of protection.

R. M. G.

THE SHOLAS OF THE PALGHAT DIVISION,—A STUDY IN THE ECOLOGY AND SILVICULTURE OF THE TROPICAL RAIN-FORESTS OF WESTERN GHATS.

PART I.

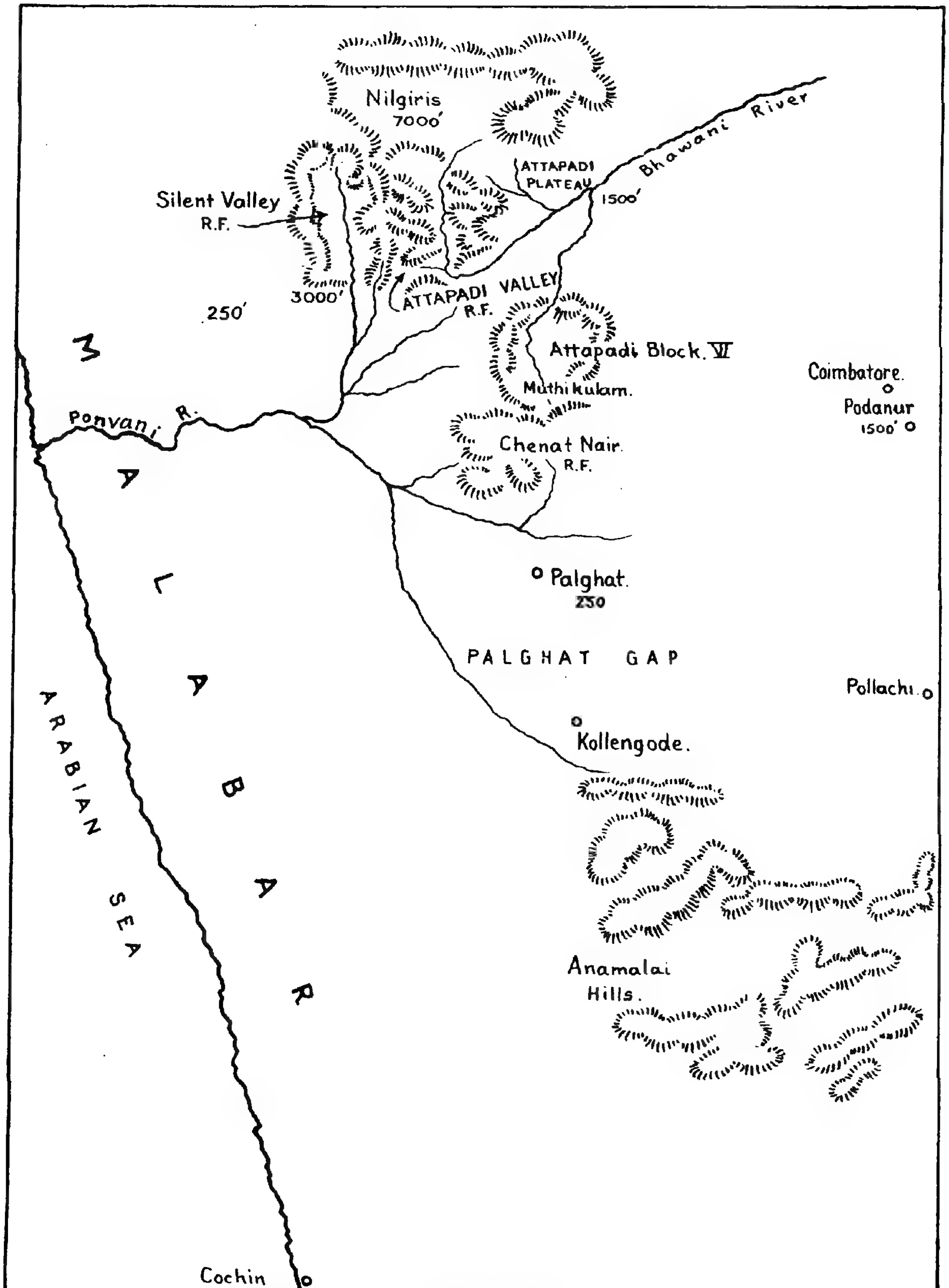
BY T. V. V. AIYAR, P.F.S.

1. The floristic composition of the tropical rain-forest formation varies with the physical features of its locality, as does any other type of vegetation, so that a brief outline of the local geography will be useful in appreciating the differences that will be noticed in the course of these notes. The accompanying sketch may be referred to with advantage.

2. *Situation.*—The unbroken ridge of the Western Ghats stretching southwards from Bombay ends abruptly at Palghat, to begin again some twenty miles further south on its downward journey to Cape Comorin. This breach in continuity is the well known Palghat Gap, the only one of its kind in our western fortifications. The forests occupy the last twenty miles of the southern extremity of the Ghats to the north of the Palghat Gap. They lie between north latitudes 10°—48′ and 11°—12′ —30″ and east longitudes 76°—22′—30″ and 76°—45′. Their total area is over 140 square miles.

3. *Configuration.*—The Western Ghats, on which these forests thrive, lie about fifty miles away from the Arabian sea. To the west are the undulating plains of Malabar dropping from 300 feet at the foot-hills to the sea-level. On their east is the plateau of the Carnatic. The main ridges run north-to-south, with variations at their southern terminus. Three main natural sub-divisions are apparent,—the parallel north-to-south valleys of the north, the plateau of the middle, and the radiating valleys of the south.

The Valleys of the North.—Two valleys run from north-to-south—the Silent Valley to the west (so-called because it is uninhabited) and the Attapadi Valley on the east. The Silent Valley is protected on the west by a watershed rising from 4,000′ at the southern end to the Nilgiri plateau on the north at 7,000′. The southern exit from the valley at an elevation of 3,000′ is precipitous. On the east a ridge somewhat higher separates it from the Attapadi Valley. The Attapadi Valley falls



Scale 1" = 32 Miles (approx)

from the Nilgiri Plateau on the north to 2,000′ on the south. A ridge, slightly lower than the one separating it from the Silent Valley, protects it from the eastern plateau. There are five forest blocks in it.

The Plateau in the Middle.—This is the Muthikulam Plateau comprising Attapadi Block VI. Its southern boundary is a high range 5,000′ to 7,000′ in elevation. The eastern boundary rises from 3,000′ to 6,000′. The west is comparatively low, varying from 2,500′ to 4,000′. The general level of the plateau is some 3,000′ and the drainage is northwards.

The Valleys of the South.—The southern extremity of the Ghats forms the Chenat Nair Reserve. The main ridges run from west to east, but spurs radiate in all directions except north, forming valleys facing west, south or east. The elevation rises from 250′ at the foot-hills to Palamalai, 5,700′.

4. *Geology, rock, and soil.*—The rocks are Archaean, Nilgiri gneiss forming the main skeleton of the hills. Metamorphism has resulted in hornblende schists in places, giving rise to a loose sandy sub-soil. The soil is ferruginous generally, and laterite is common on the foot-hills. Yellow to red clayey loam of fair depth is the prevailing soil on the hills. It is well drained on the slopes but swampy conditions are common where the slope is small.

5. *Rainfall.*—The rainfall is heaviest on the outer slopes and in the valleys facing westwards, the precipitation within the valleys increasing progressively towards their head. Of two parallel valleys, the western one receives more than the other. Valleys facing east receive the least. In the Silent Valley, Nilikal at the southern extremity receives 250 inches of rain annually on the average. The rainfall increases as we proceed northwards towards the head of the valley and at Walakkad at the north end it is estimated to be no less than 300″. The heaviest falls are in the south-west monsoon, from June to September. After crossing two high ridges, the clouds have less rain for the Attapadi Valley, and a third ridge further depletes what reaches its eastern slopes.

The north, west and south-west of the Muthikulam Plateau receive more rain than the eastern end, which gets more during the north-east monsoon than all the other valleys, as it is nearest to the Carnatic Plateau, from which it is separated by only one range of hills.

The Chenat Nair Hills, with the exception of the Kalladikode Valley, receive less rain than most of the other areas, as they are situated directly to the north of the gap. But the Kalladikode Valley faces due west and has the Palamalai peak, 5,700′ at its head, so that it receives an estimated fall of about 250″. Other valleys facing eastwards receive less rain in the south-west monsoon, but the deficiency is usually made up during the north-east, as there are no high hills further eastwards. Their average rainfall exceeds 150 inches.

6. *Past History.*—A short history of the *sholas* is essential to give an idea of the extent to which human intervention has influenced past conditions which have given rise to the present grouping of the communities.

The Silent Valley was constituted a reserved forest in 1914 and no departmental extraction has taken place in it until the experimental selection fellings of 1928-29, which have continued to this date. These fellings were limited to a maximum of three trees per acre. The species extracted were mainly *Mesua ferrea*, *Palaquium ellipticum* and *Calophyllum elatum*. Owing to the existence of large areas of adjoining private forests no felling appears to have taken place in these comparatively inaccessible areas prior to reservation, except for the extraction of *Dysoxylum malabaricum;* there are signs that this species has been exploited in the past, but the fellings could not have exceeded about one tree per ten acres, so that the Silent Valley may be considered to be practically a virgin stand.

The Attapadi Blocks I to IV were reserved in 1900 and Block V in 1912 and though past exploitation of its deciduous areas by private individuals and destruction by shifting cultivation has been excessive, the *sholas* do not appear to have been touched any more than in the Silent Valley. The Attapadi Block VI was acquired in 1912 for about a lac of rupees. Here too, so far as the existing *sholas* are concerned,

only *Dysoxylum malabaricum* appears to have been removed before acquisition. There has been no departmental exploitation since reservation.

The Chenat Nair Reserve exhibits a different story. The forests were an escheat and were reserved in 1887. Fellings must have taken place in them before they came under the control of Government, as the area is within five miles of the town of Palghat and the South Indian Railway. Unregulated departmental fellings for the extraction of *shola* species like *Calophyllum elatum*, *Dysoxylum malabaricum* and *Acrocarpus fraxinifolius*, have been recorded since 1887 almost every year, culminating in the American logging methods of 1920-29 over a large part of the area. This reserve is therefore by no means " untouched by hand."

7. *The Forests.*—The West Coast region of the Indian Peninsula is characterised by a heavy rainfall, mainly concentrated in the season of the south-west monsoon, from June to September. This heavy rainfall promotes a luxuriant vegetation, which aspect and elevation have so influenced as to form three broad and distinct types of plant communities which have been recognised as—

(1) Mixed Deciduous or Monsoon Forests,

(2) Tropical Evergreen or Rain-Forests, locally known as *sholas* and

(3) Sub-tropical or Temperate Evergreen Forests.

The Monsoon Forests extend from the sea-level to about 2,000′ on the outer slopes of hills, but may rise up to 3,000′ on dry southerly or easterly aspects or on rocky outcrops with shallow soil.

The Tropical Rain-Forest formation is at its optimum between 2,500′ and 3,500′, but may descend to 2,000′ or lower under favourable conditions of aspect and humidity, merging into the Monsoon Forests below, along perennial streams. It merges into the Temperate Evergreens above 5,000′.

The Sub-tropical or Temperate Evergreen formation is distinct at an elevation of about 5,000′ and thrives best at higher levels, but merges often into the Tropical Rain-Forests between 4,500′ and 5,000′.

8. *The Tropical Rain-Forests* (*sholas*).—In these forests the dominant first story usually varies from 100′ to 150′ in height, and consists generally of :—*Cullenia excelsa*, *Machilus macrantha*, *Elaeocarpus tuberculatus*, *E. munroii*, *Palaquium ellipticum*, *Mesua ferrea*, *Calophyllum elatum*, *Canarium strictum*, *Dysoxylum malabaricum*, *Vateria microcarpa*, *Poeciloneuron indicum*, *Eugenia* sp. *Heritiera papilio*, *Chrysophyllum roxburghii*, *Mangifera indica*, *Artocarpus integrifolia*, *Polyalthea coffeoides*, *Cinnamomum zeylanicum*, *Holigarna arnottiana*, *H. grahamii*, *Meliosma arnottiana*, *Hopea glabra*, *Litsaea wightiana*, *Mastixia arborea*, *Hemicyclia alata*, *Cyclostemon confertiflorus*, *Strombosia ceylanica*, and *Filicium decipiens*.

In the second story are usually present :—*Myristica laurifolia*, *Hydnocarpus wightiana*, *H. alpina*, *Nephelium longana*, *Lansium anamalayanum*, *Garcinia spicata*, *G.* sp. *Elaeocarpus serratus*, *Adenochlaena indica*, *Gomphandra polymorpha*, *Gordonia obtusa*, *Eugenia* sp., *Baccaurea courtallensis*, *Glochidion malabaricum*, *Canthium didymum*, *Litsaea stocksii*, *Scolopia crenata*, *Xanthophyllum flavescens*, *Mappia fœtida*, and *Actinodaphne hookeri*.

The shrubby third story consists usually of :—*Euonymus angulatus*, *Agrostistachys indica*, *A. longifolia*, *Eugenia munroi*, *Eugenia laeta*, *Paramignya armata*, *Sauropus albicans*, *Leea sambucina*, *Saprosma fragrans*, *Webera* sp., *Clerodendron infortunatum*, *Macaranga roxburghii*, *Strobilanthes* sp., *Laportea crenulata*, *Olea dioica*, *Linocera malabarica*, *Callicarpa lanata*, *Pavetta zeylanica*, *Vernonia arborea*, *Lepisanthes deficiens*, *Turpinia malabarica*, *Orophea uniflora*, *Sarcococca brevifolia* and *Croton scabiosus*.

The monocotyledons are represented by :—*Arenga wightii*, *Pinanga dicksonii*, *Calamus* sp., *Pandanus furcatus*, the reed *Ochlandra beddomei*, and herbaceous species like *Elettaria cardamomum*, wild arrowroot and some of the *Araceae*.

The climbers, which are not as abundant or as numerous as in semi-deciduous forests, are represented by: –*Gnetum scandens*, *Calamus* sp., *Smilax macrophylla*, *Elaeagnus latifolia*, *Derris* sp., *Entada scandens*, *Senecio araneosus*, *Thunbergia mysorensis*, *Paramignya armata*, *Luvunga eleutherandra*, *Morinda* sp., and *Fagraea oborata*, an epiphyte.

Herbaceous ground-flora are meagrely represented within the *shola* by cardamoms, *Curcuma* sp. and *Heckeria subpeltata*.

It may thus be seen that the number of species is extraordinarily large, as is true of rain-forests in general. Other typical features are :— plank buttresses exhibited by *Elaeocarpus tuberculatus*, *Pœciloneuron indicum*, *Cullenia excelsa*, *Heritiera papilio*, *Palaquium ellipticum* and *Acrocarpus fraxinifolius* ; prop-roots, by *Pœciloneuron indicum* and *Myristica laurifolia* ; and culiflory, strikingly manifested by *Polyalthea coffeoides*, *Artocarpus integrifolia*, *Baccaurea courtallensis* and *Cullenia excelsa*, not to speak of the several species of *Ficus*.

9. *Rain-Forest Sub-types.*—The several distinct plant-communities that may be recognised within the main Rain-Forest formation form an interesting and instructive study.*

Eight different associations may be recognised within our rain-forest formations —

1. The Cullenia-Palaquium Association
2. The Palaquium-Mesua Association,
3. The Pœciloneuron-Palaquium Association,
4. The Reed-Calophyllum Association,
5. The Reed-Pœciloneuron Association,
6. The Mesua-Calophyllum Association,
7. The Vateria-Cullenia Association, and
8. The Vateria-Mesua Association.

*The nomenclature that has been employed in naming the various plant-communities is that adopted by Tansley and Chipp in their "Aims and Methods in the study of Vegetation," published by the British Empire Vegetation Committee.

1. The Cullenia-Palaquium Association.

This community, the dominant species of which are *Cullenia excelsa* and *Palaquium ellipticum*, is the most widespread occurring within the area. It grows on deep, well-drained soil, so that the dominants as well as the other associates are of the best quality. It affects elevations between 2,500′ and 3,500′, and aspects with comparatively heavy rain, but does not tolerate swampy soil conditions, even of a temporary nature, as occur in some places during the monsoon.

The presence of *Cullenia* may be taken as a safe indication that the conditions are suitable for the best growth of valuable species like *Mesua ferrea and Palaquium ellipticum,* though its absence does not necessarily indicate the reverse. The hill to the north of Chembotti elephant camp is devoid of *Cullenia* but can boast of some of the best *Palaquium* and *Mesua* in the Silent Valley. The valuable species met with in this association are *Palaquium ellipticum, Mesua ferrea* and *Calophyllum elatum*, *Cullenia* itself being not of much value.

Taking all trees above a breast height diameter of 12″, the average incidence per acre in this type of forest works out to :—

	Trees per acre.		Trees per acre.
Mesua ferrea ..	3·73	*Dysoxylum malabaricum*	0·07
Palaquium ellipticum ..	5·45	*Cedrela toona* ..	0·03
Cullenia excelsa ..	8·84	*Bischoffia javanica* ..	0·09
Calophyllum elatum ..	0·88	*Acrocarpus fraxinifolius*	0·08
Artocarpus integrifolia ..	0·11	*Hopea glabra* ..	0·49
		Eugenia sp. ..	0·11

The sub-dominants and the undergrowth are in the main those detailed under rain-forests. No correlation has been established to any marked degree between the different associations and the sub-dominants or the undergrowth of each. It is, however, possible that a more

detailed study may disclose such affinities, and an approach to the problem is indicated through the examination of the different species of *Strobilanthes* that are met with.

The *Cullenia-Palaquium* association prevails in the *sholas* of the Chenat Nair Reserve and over the Muthikulam Plateau. In the Silent Valley it is remarkable that its occurrence is strictly confined to the south of the Chembotti stream, and thence across the Kundi-puzha to the south of the Kummattan-thodu. It is not found to the north of this line. In the Attapadi Valley it is confined to the Panthan-thodu and Anangan-thodu Valleys, which are to the south of the northern limit of this association in the Silent Valley.

Throughout this community, consociations of *Cullenia* and *Palaquium* may be met with in patches, thus exhibiting a distinct tendency towards gregariousness, which is more marked in the case of *Palaquium*. Both these species are among the most shade-bearing dominants met with in these forests, and both seed profusely almost every year. Consociations of these species are therefore readily understandable. But in the case of *Palaquium*, though the ground is usually carpeted with seedlings up to a foot high, advance-growth and poles are woefully lacking except where a break in the canopy has helped to stimulate growth.

One conspicuous variation of this association is that which occurs over an area of about 200 acres to the south of Anangan-thodu in Attapadi Block 1. The elevation is about 3,750′ and ridges rising to 5,000′ protect it on the south and west. Both *Cullenia* and *Palaquium* are found, but neither is at its best, nor do they occur with any pretence of gregariousness. But the conditions are not so prejudicial to *Mesua* so that this species is predominant and occurs in considerable numbers. The quality is second only to that found in the best *Cullenia-Palaquium* association, and is better than in the *Mesua-Calophyllum* association. Regeneration of all ages is conspicuous. *Calophyllum elatum* is also found.

The reason for this variety of the *Cullenia-Palaquium* association is not far to seek. The area is sufficiently protected on the south and west to receive that amount of rain which falls short of the optimum for

these species, but they still occur. The conditions fall short of the optimum to a lesser degree of *Mesua*, so that the competition from these two dominants is very much less. Hence we get a larger incidence of *Mesua* with only a slight fall in quality. That the locality is distinctly drier is evidenced by the frequent occurrence of *Acrocarpus fraxinifolius* in it. Observation reveals that the canopy is less dense and that more light is able to reach the ground than where *Palaquium* is at its best. In moist shady ravines, clans of the palm *Pinanga dicksonii* are a very pleasing feast to the eye. Its gregarious habit is due to reproduction from rhizomes.

2. Palaquium-Mesua Association.

This occurs in the Silent Valley only and is there confined to the area lying between that part of the valley occupied by the *Cullenia-Palaquium* association and that to its north, occupied by the *Pœciloneuron-Palaquium* association. The Thondakulam Plateau, the spurs radiating from the Poochipara Hill and the adjoining area to the east of the Kundi-puzha, are covered by this association.

The dominant species are those which give the name to the community, the conspicuous feature being the entire absence of *Cullenia excelsa* and *Pœciloneuron indicum*, species which distinguish the associations to its south and its north, respectively. The co-dominants are *Calophyllum elatum*, *Heritiera papilio*, and *Artocarpus integrifolia*. The subsidiary stories are similar to those of the previous association, but *Elaeocarpus munroii*, *Cinnamomum zeylanicum*, *Agrostistachys indica*, *A. longifolia* and *Euonymus angulatus* are more prominent. This association includes *Palaquium* consociations of good quality. It also contains finely grown *Mesua* of mature sizes, but the absence of *Mesua* of smaller diameter classes and regeneration of this species is striking. Open grassy blanks are characteristic, as well as the distinctly edaphic *Reed-Calophyllum* association. Clans of *Pinanga dicksonii* are common in moist ravines.

The elevation varies from 3,000′ to 3,750′. As the latter height is approached, *Palaquium* falls in quality and tends to disappear and

the *Mesua-Calophyllum* association begins to assert itself. The incidence of useful species is given below :—

	Trees per acre. (above 12″ diameter).
Palaquium ellipticum	8·0
Mesua ferrea	3·0
Calophyllum elatum	1·2
Artocarpus integrifolia	0·3
Hopea glabra	0·2
Dysoxylum malabaricum	0·1

3. Pœciloneuron-Palaquium Association.

The dominant species of this community are *Pœciloneuron indicum*, *Palaquium ellipticum*, *Calophyllum elatum* and *Mesua ferrea* in a descending order of prevalence. It occurs only in the Silent Valley, where it affects localities of heaviest rainfall, with very damp soil or where it is inclined to be marshy.

Pœciloneuron indicum is found elsewhere at elevations as low as 500′ (witness the lower slopes of neighbouring hills and the Someswar Forests of South Canara) provided the rainfall is heavy enough and the soil remains moist over the greater part of the year. Its absence from the locality affected by the two previous associations in the Silent Valley appears therefore to be due to insufficiency of soil-moisture, resulting from climatic and edaphic factors. In the northern half of the Silent Valley, the rainfall is decidedly heavier and more evenly distributed over the year, so that the soil is moist for a longer period and even marshy in places. This association therefore prevails in the northern half of the Silent Valley. Its minimum elevation here is limited by that of the locality (3,000′) but its maximum is fixed only by the advent of sub-tropical dryness at about 4,000′.

In marshy localities where reeds prevail to the exclusion of most other vegetation *Pœciloneuron* and to a less extent *Calophyllum* are the dominant trees. The former's stilt roots enable it to thrive here, where it often regenerates well. But it is at its best on less marshy

ground in the neighbourhood where it regenerates profusely and attains large dimensions. Regeneration, advance-growth, poles, and mature and overmature trees,—all are there in sufficient numbers to gladden the forester's eye, but the timber commands no sale, though reported to be of good quality. In well-drained localities it is associated with *Palaquium* and *Calophyllum* of good quality, but *Mesua ferrea* is sparsely distributed as it has two enemies to contend with. With the reduction in *Palaquium* at elevations above 3,500′, there is a larger admixture of *Mesua*.

The *Pœciloneuron* consociation occurs in patches of larger extent than that of any other species in these forests, thus exhibiting a strong tendency towards gregariousness under optimum conditions of growth. It appears to be a comparatively easy matter to grow it in pure crops and to regenerate it successfully under a suitable shelter-wood system.

Apart from this consociation the co-dominant species are *Heritiera papilio, Cullenia excelsa* and *Vateria macrocarpa*. The sub-dominant species are those common to other associations generally.

4. REED-CALOPHYLLUM ASSOCIATION.

This community and the succeeding one are localised edaphic climaxes, situated within wider associations. On the Thondakulam Plateau of the Silent Valley and on the western slopes to the south of Kathisundan are considerable stretches of reeds (*Ochlandra beddomei*) inhabiting marshy tracts over which small streams stagnate for the greater part of the year. The ground is a series of pits and mounds when dry. Standing over the reeds as standards over coppice are trees dotted about, chiefly *Calophyllum elatum*, *Hopea glabra*, *Eugenia* sp., and *Bischoffia javanica*. The pit and mound formation helps the regeneration of the trees as the mounds afford the necessary degree of drainage to prevent the rotting of seedlings.

The rainfall is not sufficient for the occurrence of *Pœciloneuron indicum* which is conspicuously absent. The undergrowth consists largely of *Agrostistachys indica* and *A. longifolia* among the reeds.

The *Calophyllum* shows the same tendency to stag-headedness that it exhibits at elevations above 4,000′, though its occurrence under such widely different conditions is worthy of note.

5. Reed-Poeciloneuron Association.

This is another edaphic climax prevalent under conditions of heavier rainfall, where the soil is inclined to be marshy. It has already been referred to under the *Pœciloneuron-Palaquium* association, as it is a variation of that association met with under marshy conditions. This community is similar to the previous one, except that, in addition to the other dominant associates common to both, there is a wide prevalence of *Pœciloneuron indicum*. The latter forms the chief dominant crop as *Calophyllum* did in the last. It is confined to the banks of the Kundi-puzha in the Silent Valley, where it adjoins the *Pœciloneuron-Palaquium* association.

6. Mesua-Calophyllum Association.

At elevations above 3,500′ the optimum conditions for *Palaquium ellipticum* are on the wane and the *Mesua-Calophyllum* association takes the place of the *Palaquium-Mesua* one. As the critical elevation is approached, the quality and quantity of *Palaquium* fall off rapidly, and the incidence of *Mesua* and *Calophyllum* increases, though their quality as expressed by height-growth also falls off to a marked degree. There is in addition a considerable increase in the regeneration, advance-growth and poles of *Mesua ferrea*, all of which are deplorably short in the other *Mesua*-bearing associations. Neither *Mesua* nor *Calophyllum* grow to large size here but the deficiency is made up in the larger number of stems per acre.

The association thrives up to an elevation of about 4,500′ beyond which *Mesua* tends to disappear, though *Calophyllum* struggles on in a more stunted form up to 5,000′ where the tropical rain-forest merges into the sub-tropical evergreen. There is also a marked change in the associated species and in the under-growth. The associates are mainly :—*Litsœa oleoides, L. stocksii, Gordonia obtusa, Elæocarpus munroii, Cinnamomum zeylanicum, C. sulphuratum, Eugenia* sp.

Symplocos spicata, *Alseodaphne* sp., *Actinodaphne bourdilloni*, and *Actinodaphne* sp. The understory is characterised by a heavy growth of several species of *Strobilanthes* up to twenty feet in height which retards regeneration considerably.

The association has a wide prevalence wherever the elevation is between 3,500′ and 1,500′. It occurs between Walakkad and Sispara, round about Poonmalai and Havelock's; the bits of *shola* which have escaped destruction on the tops of ridges in Attapadi Blocks I to V are of this type. Where these last bits of *shola* descend to slightly lower elevations or are situated on easterly slopes, admixture of *Acrocarpus fraxinifolius* and *Cedrela toona* indicates a descent to the semi-evergreen type, due to comparative dryness. The type also appears in Attapadi Block VI, near the Muthikulam waterfall and on the Velligiri slopes at elevations in the neighbourhood of 4,000′. In Bolampatti Block II the lower half belongs to this type except where *Vateria* occurs. Within the community, consociations of *Mesua* and *Calophyllum* are a marked feature.

7. VATERIA-CULLENIA ASSOCIATION.

It may be mentioned at the outset that not a single specimen of *Vateria macrocarpa* has been observed anywhere within the area under survey outside the Muthikulam Plateau (Attapadi Block VI), where, however, the tree occurs in profusion, often in gregarious patches, and grows to enormous dimensions. The species has been declared to be different from *Vateria indica* and has been named *Vateria macrocarpa*.

The association is confined to Attapadi Block VI and to the *sholas* of Bolampatti Block II and to the dampest parts of these blocks where the aspect favours a heavy precipitation, as on westerly slopes and in the neighbourhood of low westerly saddles, or where a network of perennial streams keeps the soil always moist but well-drained. Here *Vateria* grows to perfection, almost to the exclusion of other dominants. Its gregariousness is very marked and its regeneration is second to none, not even *Poeciloneuron*. *Vateria* conso-

ciations are therefore the rule in this community, which should be considered an edaphic climax for the reasons set forth above.

The co-dominants are *Cullenia excelsa*, *Palaquium ellipticum*, *Mesua ferrea*, *Calophyllum elatum*, *Polyalthea coffeoides* and an occasional *Poeciloneuron indicum*. The subordinate species are the same as in the *Cullenia-Palaquium* association.

8. Vateria-Mesua Association.

Above an elevation of about 4,000′ *Cullenia excelsa* does not thrive and the height growth of *Vateria macrocarpa* suffers considerably. The *Vateria-Cullenia* association of lower elevations gives place to a *Vateria-Mesua* association under these conditions. This community is confined to the neighbourhood of streams and to comparatively moist slopes. It is confined to the north-east corner of Attapadi Block VI and to the *sholas* of Bolampatti Block II, above an elevation of about 4,000′.

The dominant species is *Vateria macrocarpa*, which is as gregarious as in the last association but of considerably less height growth. The co-dominants are *Mesua ferrea* and *Calophyllum elatum*. The subordinate species are similar to those found in the *Mesua-Calophyllum* association and there is usually a thick undergrowth of some species or other of *Strobilanthes*. *Vateria* regeneration is nearly as prolific as in the previous community.

10. Succession in Rain-forests.

The successional series that invade the ground wherever there has been a set-back from optimum conditions, natural or artificial, often afford valuable clues to the proper sylvicultural treatment of these forests, and to the proper approach to the methods of afforestation of destroyed *sholas* and of open grass-land. Such regressions may be found in—

A. Landslips, and in the tea-estate at Walakkad in the Silent Valley, abandoned some 50 years ago.

B. Grass-land formations adjoining *sholas*.

C. The *sholas* of the Chenat Nair Reserve, heavily damaged by American logging methods.

D. The paths usually followed by herds of wild elephants, and the heavily worked privately-owned *sholas* adjoining our reserves.

E. The gaps of different sizes, created by light selection fellings in the Silent Valley and by the old unregulated fellings in the "unlogged" areas of the Chenat Nair Reserve.

A. DESTROYED SHOLA.—The highest degree of regression has been caused in landslips and in the abandoned tea-estate, higher in the former than in the latter. Dotted about in a sea of grass may be observed a species of bracken (a fern) and colonies of *Wendlandia notoniana*, a species with very light seeds. A kind of ground-orchid is much in evidence after a fire and the open ground teems with the spathes of its pink-and-yellow flowers. In some localities, as round Palamalai in Chenat Nair, *Hypericum mysorense* is also prevalent.

Colonies of *Maesa perrottettiana* and *Glochidion malabaricum*, independent invaders from the edges of the *shola*, soon succeed, and are in turn followed by consocies of *Gordonia obtusa* and *Symplocos spicata*. These latter are a very marked feature of the rehabilitation of destroyed *sholas* (witness the naturally afforested portions of Walakkad tea-estate and the neighbourhood of Palamalai rest-house) and are a pleasing feature of the landscape. The individual trees are rarely over a foot in diameter and over 30 feet in height, but they grow closely packed and their light foliage and white flowers are very attractive.

The succession develops later into an associes of *Acronychia laurifolia, Elæocarpus munroii, Meliosma arnottiana, Litsaea stocksii, Olea dioica, Allophylus cobbe and Linocera malabarica* and finally passes into one of the climax communities mentioned above. *Calophyllum elatum* and *Mesua ferrea* are among the first entrants into the climax, yielding place later to *Palaquium ellipticum* and *Cullenia excelsa*, if the conditions are suitable.

B. (*i*). GRASS-LAND ADJOINING SHOLA.—On the edges of grass-land adjoining a *shola*, the subsere is not thrown so far backwards.

Wendlandia and *Glochidion* are not always a necessary preliminary phase. *Symplocos spicata*, *Gordonia obtusa*, *Linocera malabarica*, *Croton scabiosus*, *Maesa perrottettiana* and *Acronychia laurifolia* are followed by *Macaranga roxburghii* and *Clerodendron infortunatum*, and succeeded later by *Elaeo carpus munroii and E. serratus*, *Meliosma arnottiana*, *Canarium strictum*, *Canthium didymum*, and *Vernonia arborea*. The climax follows with the invasion by *Calophyllum elatum* and *Mesua ferrea*, and finally by *Cullenia* and *Palaquium* if suitable. The importance of preserving *Calophyllum elatum* and *Mesua ferrea* on the margins of *shola* adjoining grass-land will be evident from the nature of the succession revealed in the last two cases.

In comparatively dry localities, as to the south of the Muthikulam bungalow to the north of the waterfall, an almost pure crop of *Acronychia laurifolia* has invaded the grass next to the *shola*. A few *Maesa*, *Glochidion*, *Macaranga* and *Kydia calycina* occur mixed with this species.

B. (*ii*). Grass-land with shallow, rocky soil.—On open areas with shallow rocky soil *Phyllanthus emblica*, shrubby *Dalbergia latifolia*, *Sterculia guttata* and *Erythrina indica* first appear among the grass, and are followed by *Lagerstroemia lanceolata* and *Sapium insigne*. These give place to colonies of *Heritiera papilio*, a species that affects rocky out-crops in *sholas*.

Calophyllum elatum follows later and then *Mesua ferrea*, if the locality is not too dry. The conditions are, however, likely to remain unsuitable for *Palaquium* or *Cullenia* for a very long time, as neither of these thrives on shallow, rocky soil.

C. (*i*) Logged sholas of Chenat Nair.—In these areas all timber down to a breast-height-diameter of one foot was removed, leaving behind the advance-growth of useful species. The sudden exposure and the strong monsoon winds destroyed most of these. A mass of weeds immediately took possession of the ground, out of which emerged in the course of two or three years soft-wooded, fast-growing species such as *Leea sambucina*, *Trema orientalis* and *Macaranga roxburghii* which are now 25 to 30 feet high. Under the low shade of

these soft woods, regeneration of the evergreen species of the locality has either managed to survive or has later come into being in some quantity. These belong to *Calophyllum elatum*, *Artocarpus integrifolia*, *Heynea trijuga*, *Lansium anamalayanum*, *Mesua ferrea*, *Palaquium ellipiticum*, and a few other species. Where the conditions have been further setback species typical of semi-evergreen forests like *Acrocarpus fraxinifolius* have spread naturally, as in Fischer's Burn. In what manner natural succession may be speeded up in these areas is a subject for future experiment.

C. (*ii*). LOGGED SEMI-SHOLAS OF THE CHENAT NAIR RESERVE.—These semi-evergreen areas border on the true *sholas* and contain a few *Calophyllum elatum* and *Mesua ferrea* among species like *Artocarpus hirsuta*, *Acrocarpus fraxinifolius*, *Lagerstroemia lanceolata*, *Bischoffia javanica*, *Chukrassia tabularis*, *Cedrela toona*, *Hopea parviflora* and *H. wightiana*.

Soon after the logging, the gaps were alive with numerous seedlings of *Acrocarpus fraxinifolius*, *Chukrassia tabularis*, *Cedrela toona*, *Lagerstroemia lanceolata* and *Bischoffia javanica*, the fruits or seeds of which are light. There were weeds,—*Trema orientalis*, *Macaranga roxburghii* and *Caesalpinia mimusoides* but they did not then look sufficiently menacing. At the end of the first year, the weeds began to get the upper hand, and many of the seedlings of these valuable species have been suppressed, while by the end of the second year only a few were able to over-top the weeds and survive. It will therefore be seen that the same weeds that help to preserve the regeneration of the evergreen species are very destructive to that of the semi-evergreen like *Chukrassia tabularis* and *Acrocarpus*.

D. HEAVILY WORKED PRIVATE FORESTS.—Unlike the simultaneous logging of all timber, saleable or unsaleable, that was practised in the Chenat Nair forests, private owners deplete a *shola* gradually over a series of years, removing the largest and most valuable timbers first, then the less valuable species and smaller sizes, and so on until nothing economically extractable is left behind. The process is therefore selective and gradual. *Dysoxylum malabaricum*, *Palaquium*

ellipticum, *Calophyllum elatum* and *Mesua ferrea* has been the order of demand and therefore of the supply.

The original crop is now in a deplorable state, no doubt, but is far from wiped out as in the Chenat Nair Reserve. A selection felling of about thirty of the most valuable trees per acre would describe the condition fairly well. The result has been a mass of *Macaranga*, *Leea*, cardamoms, and various other soft-wooded and herbaceous species, but in amongst this growth, and elsewhere, the natural regeneration of valuable species like *Palaquium ellipticum* has had suitable conditions for developing, owing to the admission of light. The result is apparent in the appreciable amount of advance-growth of *Palaquium ellipticum* that may be found here.

E. Gaps caused by Selection Fellings.—Selection fellings limited to a maximum of three trees per acre were started in the Silent Valley in 1928. The species felled were *Mesua ferrea*, *Palaquium ellipticum* and *Calophyllum elatum*, chiefly. The size of the gaps so created varies from about $50' \times 30'$ to anything up to $100' \times 66'$. The nature of the invading subsere that follows the fellings depends to a marked degree on the size of the gaps. The understory usually disappears during extraction.

Under the lightest gaps, almost the only invader is the cardamom plant, *Elettaria cardamomum*, which has some economic value. Young regeneration of *Palaquium*, of which there is usually a large amount, and of *Mesua*, receive very satisfactory conditions for establishment, and where the cardamom is interfering it can be cut away at little cost. The regression from the climax is made good in a short time and with judicious cultural operations the incidence of useful species may be improved considerably in the succeeding climax community. A substantial revenue from the cardamoms may also be expected.

Somewhat larger gaps where *Heckeria subpeltata* and the dreaded " Devil's nettle," *Laportea crenulata*, appear along with the cardamom are more prevalent, however. The nettle is easily managed if one realises its presence and takes elementary precautions against being stung.

The largest gaps are invaded by a short, light grass, *Laportea crenulata*, *Macaranga roxburghii*, *Leea sambucina*, wild plantain, a species of *Scitaminae*, and *Toddalia asiatica* in the first year, and cardamoms appear later under their shade. More interference is demanded for preventing the stagnation of natural regeneration where it exists and young *Palaquium* is not likely to stand the large opening created. But the conditions permit the introduction of new species suited to the locality, like *Gluta travancorica* from Tinnevelly. They also enable the introduction in the centre of the largest gaps of valuable species like *Acrocarpus fraxinifolius* and *Artocarpus hirsuta*, which are occasionally met with in these forests, and thus decidedly increase their economic value.

[The remainder of this paper, consisting of a silvicultural analysis of the important individual species, will be printed in our September number—Hon. Ed.].

A RHINO IN DIFFICULTIES.

BY W. R. MARTIN, I.F.S.

The enclosed photograph (Plate 23) shows a young rhino which strayed recently from the Kaziranga Game Sanctuary in the Sibsagar District, and became bogged in a shallow well near the Methoni Tea Estate. The thick mud held it so firmly that for several days it was unable to extricate itself.

Mr. Skene, the manager of the Tea Estate made himself responsible for its protection, and fed and watered it during its imprisonment. The protection of a helpless rhino from a crowd, every member of which would be glad of an opportunity to spear or shoot it in order to get a portion of its precious flesh or horn, was a considerable undertaking, and involved the posting of *chaukidars* over it night and day.

At the outset the rhino was exceedingly angry and very definitely discouraged any attempts to approach too close to it. But after two or three days it had become so subdued that it allowed Mrs. Skene to feed it with grass from her hand, and even to stroke its head.

A young rhino which was bogged in a mud-hole in Methoni Tea Estate, Sibsagar.

During the several days of its captivity there was no rain, and the mud in which it was bogged gradually became firmer until eventually it was firm enough to provide a foot-hold. The rhino discovered this during the night, and the following morning the only trace of it was a line of footprints indicating a hurried return to the seclusion of the Sanctuary.

SAL AND ITS REGENERATION IN THE UNITED PROVINCES

By R. S. Hole.

All true lovers of the forests of India will, I feel sure, welcome the article under the above title, by Mr. Smythies, which was published in the April number of this volume of the *Indian Forester*, inasmuch as it clearly emphasizes the only possible way by which really sound progress can be secured, *viz.*, the patient experimental testing of theories, careful observation of the results obtained under varying experimental conditions and honest, unprejudiced publication of the same, with suggestions for future work. Before the difficult problem of *sal* regeneration can be profitably discussed, it is necessary to deal with a matter which, to some extent at least, is responsible for many of our difficulties, *viz.*, the common habit of attempting to define clearly and completely matters about which at present very little is really known, in other words the habit of allowing our predilection for complete and precise definitions to carry us considerably further than is really warranted by our actual knowledge. Mr. Smythies quite rightly points out that a *sal* forest is by no means a permanency and, personally, I think the use of the word *climax*, in the present state of our knowledge, is undesirable, because it tends not only to give the impression of a permanency which does not in fact exist, but also implies that the climax in any particular locality is necessarily the result of the same kind of succession. It is quite true that in each locality a certain type of vegetation can usually be more or less clearly recognized as the most highly developed type possible, under the generally prevailing climatic conditions, and towards which some at least of the other local forms of vegetation in time tend to approximate, provided their development is not obstructed by fires, grazing or other injurious influences, but our present knowledge of Indian forests,

at least, is usually quite insufficient for us to say that the so-called "most highly developed, or final type" is not itself undergoing more or less considerable change, or to predict with any certainty, for any particular type of vegetation, the precise course of succession it will naturally follow in the future. In forest œcology in India, at present, the really important thing, I think, is to obtain, as opportunity offers, as careful and detailed descriptions as possible of all important existing types of forest vegetation in each locality, of the conditions of at least the most important environmental factors in operation in each case and of the actual course of succession which each type actually follows, under the prevailing conditions, taking care meanwhile not to hamper ourselves by employing a number of precise technical terms and definitions which imply that we know far more than we really do. It must be remembered that if we employ a technical term which implies more than we really know, we actually set up what is in fact, to some extent, an obstacle to true progress. If, for instance, a term is applied to a type of vegetation which implies that this type has arisen in a particular way and will proceed to develop in a particular way, when our knowledge does not really justify these assertions, we create, as it were, a vested interest which is likely to render the future elucidation of the true facts more difficult. Much of the confusion associated with the word *species* in botany, for instance, has been caused by the fact that the Linnean definition not only attempted to describe what a species is, as it now actually exists and can be recognized in the present time, but also how it came into existence, regarding which Linnaeus said, but did not know, that it originated from a special act of creation and had remained unchanged from the creation.

Before the question of œcological succession in Indian forests, therefore, can be profitably discussed, we ought to have a clear idea of what the terms really mean which we employ. In Indian forestry, the terms xerophilous, mesophilous and hygrophilous are now commonly and usefully employed, in a general way, as indicating plants or types of vegetation existing under, respectively, unfavourable, moderately favourable and very favourable conditions of moisture supply as considered from the plants' point of view of the power of these

conditions to retard or promote its own growth. A succession from a xerophilous towards a hygrophilous type is usually termed *progressive* and one in the reverse direction *regressive.* Xerophytic conditions may be due not only to the physical absence or scarcity of water in the habitat, but to such factors as an excess of valuable salts, or a deficiency of oxygen for respiration in the water in the neighbourhood of the roots, which prevents a plant from making full use of the water present in the habitat for the purposes of healthy growth and development. Our idea of what these terms really mean, however, is as yet too vague to admit of really profitable discussion from a scientific point of view, except only in a very general way and we require (1) the general acceptance of an œcological classification of our forests into main types differing widely from one another as regards the component specie and habit of growth, *e.g.*, Coniferous Woodland, Broad-leaved Deciduous Woodland, Broad-leaved Evergreen Woodland, Palms, Bamboos, Grassland and so on, and (2) agreement regarding some standard of measurement which will enable us to separate one and the same main type of vegetation accurately into xerophilous, mesophilous and hygrophilous forms. It is possible that from a forest point of view, at any rate, the best standard of measurement to adopt, as regards this point, would be based on the average annual production of organic matter for unit of area, obtained by dividing the dry weight of the crop at maturity by its age in years. This standard, for instance, would take into account such important factors as the dimensions attained by the individual plants, the dry weight of organic matter produced by them, the rate of growth, the amount of water available for growth and the density of the stocking. Until some such standard of measurement is adopted, it is not always possible to say with any accuracy whether a change from a particular form of *sal* forest, for instance, to a particular form of evergreen or miscellaneous forest is to be regarded as a progressive or regressive form of succession. It must of course be remembered that, whereas in dry types of *sal* forest, such as many of those in the United Provinces and Central Provinces, the appearance of *rohini* (*Mallotus philippinensis*) or other miscellaneous species, under the influence of fire protection, may introduce more favourable

conditions of soil and soil moisture for the growth of *sal* seedlings, in moist or wet *sal* forests the effect may be precisely the reverse.

The principal factor which influences the growth of *sal* seedlings in the plains' forests of the United Provinces (with the exception of the more favoured eastern districts), which is of no practical importance in the moist forests of Bengal and Assam, is frost and it was largely on account of this factor that I advocated the adoption of north-south cleared strips, which also secure favourable conditions of moisture supply. Mr. Smythies says that in the practical large-scale application of the strips recommended by me " the strips failed everywhere," but, so far as I am aware, the method of strips suggested by me was never really tried, as I intended it to be tried. Up to the year 1919, it is true that I advocated broad-cast sowing on the strips, but subsequent experience led me to modify this. Grass subsequently often became established in such sowings which attracted rats and the latter did great damage by biting through the succulent roots of the *sal* seedlings and saplings. In some cases also considerable damage was done by deer. In 1922, in consequence, I tried at Lachiwala the experiment of narrow north-south cleared strips, the sowing of *sal* being confined to small patches, dug at intervals along the centre-line of the cleared strips, all coppice shoots on the strips being allowed to develop and only being cut back when actually interfering with the developent of the *sal* seedlings. It was hoped that the growth of the coppice shoots, combined with the scattered nature of the sowings, would reduce or prevent the invasion of grass, as well as the damage by rats and deer. As I left India early in 1923, I had no opportunity of seeing personally the results of this experiment. The idea was to obtain as much reproduction as possible first by preliminary work, *e.g.* by periodic burning of the dead leaves in moist forests, and then to increase the numbers of seedling *sal* by sowing up small scattered patches on narrow cleared lines. In *sal* forests of the dry type, where preliminary burning is inadvisable and fire-protection results in increasing the advance growth of miscellaneous species, the proportion of *sal* in the final crop might also be increased in this way.

As regards Jaspur and similar areas, it is not, I think, necessary to regard any change in the general climatic conditions of the locality as being responsible for the failure of regeneration. In such areas, the injurious effects of such factors as unregulated fellings, heavy grazing and fires, over a long period of years, have been so great that any considerable improvement of the crop merely by protection is either extremely slow or altogether impossible. In Jaspur, in small valleys and depressions where soil and organic matter tend to accumulate, the grass *Saccharum narenga* is often found, which in this locality usually indicates soil and moisture conditions generally favourable for the development of *sal* seedlings, and in such places a certain number of young *sal* are gradually appearing, thus indicating that there is really nothing wrong with the general climatic conditions. The area, however, is suffering severely from denudation, the result of long-continued mal-treatment in the past. The rain, falling on the higher areas and slopes, tends to run quickly off the hard soil, carrying with it seeds, fine soil and organic matter, thus producing xerophytic conditions, while at the lower levels accumulations of silt and water tend to produce water-logging and conditions of bad soil aeration. If such areas are to be brought back once more into the class of profitable, productive forest within a reasonable time, it seems essential that somewhat expensive artificial work should be undertaken more or less extensively, *e.g.*, by constructing contour-ditches, with the object of securing a more equable distribution and penetration of the rain water over and into the area.

CRYPTOCARYA AMYGDALINA NEES AND C. FLORIBUNDA NEES.

By R. N. Parker, I.F.S., Forest Botanist.

All Indian Floras appear to have followed Hooker in uniting these two species which are obviously distinct in the field and easily separable in the herbarium. Prain in Beng. Pl. II, 897, mentions *C. floribunda* Nees and apparently realized that it was not the same as *C. amygdalina* Nees but this is not quite clear since *Bengal Plants* is scarcely more than a list and the only description given of *C. floribunda* is to say that it is "a tree." Further both *C. amygdalina* and *floribunda* occur commonly in the Duars whereas

Prain only lists one of them. The main distinctions between these two species are as follows :—

Cryptocarya amygdalina Nees. Leaves not papillose, mostly rather thin, green on both surfaces, acuminate, usually narrowed towards the base. Lateral nerves almost always 6 or 7 pairs, widely spaced, often 2-4 cm. apart as measured along the midrib. Insect galls situated on the lower surface of the leaf consisting of a truncated cone with a circular disk-like thickened operculum which ultimately falls off. Young fruits ellipsoid ribbed, mature fruits ellipsoid, black.

Type—Wall. Cat. 2585 collected by Hamilton at Patgong, 26th March 1809. This is evidently Patgram, an outlying tract which has sometimes been a part of Rangpur district and sometimes part of Jalpaiguri. This species has been collected several times in Kurseong, Jalpaiguri and Buxa forest divisions as well as in Sibsagar, Assam and Insein, Burma.

Cryptocarya floribunda Nees. Leaves papillose beneath, rather thick, often coriaceous, glaucous beneath, very abruptly shortly acuminate, base rounded or sometimes narrowed. Lateral nerves 6-10 pairs, mostly well under 2 cm. apart as measured along the midrib. Insect galls irregular rounded swelling with contracted bases, almost confined to the upper surface of the leaves, the insects usually escaping by an irregular hole through the lower surface. Young fruits much thicker below than above and hence appearing to be obtusely beaked, mature fruits ovoid (brown ?).

Type described from trees grown in the Botanic Gardens, Calcutta, from seed collected in Sylhet by F. De Silva. We have specimens from trees cultivated in Calcutta under this name and dated 23rd April 1834 and one presumably still older but undated named *Laurus floribunda*. It has been collected in Kurseong, Buxa and Jalpaiguri forest divisions in Bengal, Puri in Bihar and Orissa, frequently in Assam including the Garo, Khasia and Naga hills, and in Myitkyina, Upper Burma.

In conclusion, I wish to thank Mr. C. E. C. Fischer for comparing some of our sheets of *C. amygdalina* Nees with Wall. Cat. 2585 in Kew.

AFFORESTING ABANDONED PADDY FIELDS WITH TERMINALIA TOMENTOSA.

BY L. R. SABHARWAL, I. F. S.

An experiment was initiated in Sambalpur in 1924 by Mr. J. W. Nicholson, I. F. S., to ascertain the possibility of afforesting abandoned paddy fields by transplanting entire *Terminalia tomentosa* seedlings onto mounds. The experiment was a success and the method employed is outlined below in the hope that it may be of use to those who have to deal with water-logged areas.

The experimental plot was located on flat ground in a large clearing of about 40 acres which was formerly the site of a village. The underlying rock is granulitic gneiss. The soil is fairly deep sandy loam, but is water-logged. The temperature of the locality varies from about 38° to 118°. The average annual rainfall is about 60 inches and the percentage of relative humidity 71.

Method of carrying out experiment.—Seeds were sown in nursery beds in the third week of April 1924, and were regularly watered, but the germination was extremely poor, being only about 8 per cent., while it was found that over 70 per cent. of the seeds which had accidentally been left in a basket had germinated. It was, therefore, concluded and subsequently tested that the best method of ensuring germination was to place *asan* seeds in heaps or in baskets at the commencement of the rains and to water them thoroughly so that the seeds form a mucilage round themselves, the watering being continued until the seeds begin to sprout. In this way, provided the seeds are in good condition, germination may be between 45 per cent. to 50 per cent.

If the seeds are sown in the nursery in the third week of April, or kept in baskets and watered, they are ready for transplanting about the end of July onto mounds as follows :—

Preparation of planting site.—The mounds on which the seedlings will grow should be made in May, spaced 6′ × 6′. Care must be taken that the soil forming the mounds is in intimate contact with the soil below. To ensure that this is so, it is advantageous to remove the

turf from beneath the site of the mounds and to fork the soil thus exposed to a depth of from 4 to 6 inches. Actually, the mounds were made by just heaping up the surface soil into mounds 1′—6″ to 2′ in diameter and 9″ to 1′ in height. Two weedings were carried out in the first year in August and October and one in the second year in July.

The following tabular statement shows the results of the experiment :—

Number of transplants.	Number of Seedlings surviving on the dates detailed below.			
	1924 January.	1925 January.	1926.	1931.
54	54	53	48	48

NOTE.—No enumerations were carried out during the period 1927—30.

The plants when inspected in 1925 were about 2″ to 2′ in height. The seedlings when transplanted were about 1″ in height. In December 1931 the average height was about 4′, the tallest plant being just over 5′. All the plants look bushy. Perhaps this is a characteristic of *asan* when young. On account of the uncertainty of the germination of *asan* direct sowing is not recommended.

A TROUT STREAM IN THE HIMALAYAS.

By H. M. G.

The Beas river, where it runs through the Kangra district of the Punjab, is the Mecca of mahseer fishermen. In its upper reaches in Kulu, where the water is too cold for mahseer, the Beas has been transformed during the last twenty years into a first rate trout river, thanks to the initiative of G. C. I. Howell, one time Assistant Commissioner, Kulu, and later C. H. Donald, Warden of Fisheries, Punjab.

The Beas river rises near the Rotang pass to Lahaul and flows through a deep canyon and for the first few miles of its course till near

the junction of the Solang contains no fish. It plunges in a succession of cataracts to Monali at 6,500 feet elevation, where in the pools lie a few trout, generally of large size as only the stronger fish can face the current. For the next twenty-two miles the river flows as a rough turbulent stream, but with quieter stretches, bordered by alders and grassy meadows. From Kulu downwards netting is allowed though there are still pools in which it is possible to catch fish on a rod and line.

The mountains rise on each side, their northern faces covered with deodar and blue-pine forest, and higher up vast stretches of fir forest extend to the Alpine pastures and the snow clad hills bordering on Lahaul and Bara Banghal. The scenery is charming in its variety, and now that the valley is accessible by car, is visited by officers on leave in the hot weather.

In March and April the water is clear and not too heavy for fly fishing ; in May the melting snow clouds the water and swells the stream till the middle of September when the water again clears and the fly can again be used. From May till the middle of September the fish become bottom feeders, and although they can be caught very occasionally on a fly, minnow or spoon, the fly fisherman must possess his soul in patience and sooner or later is driven to use the worm. As an officer, trained in Ireland and an adept at fishing a worm up stream, said to me when I first fished the Beas two years ago, "Very well, you *fly* fish and I'll catch fish." This he proceeded to do to my great chagrin !

In April this year, however, conditions were reversed and the trout took the fly greedily. The dry fly fisherman has little opportunity to practice his art as the water is swift and the fish take a sunk fly for preference. Cast across the stream and let the line swing across, hang on for a short time and draw the fly slowly up stream, if you do not get a rise. Forget the flies you used in England and use Sea trout flies with large No. 6 hooks and preferably of gaudy colour, though large March Browns prove attractive to the trout. So when they are on the rise do flies of almost any shape or colour. An Alexandra or Butcher

is deadly. Later on as the stock of shop-tied flies became exhausted, we made our own of peacock and monal feathers with tinsel and red bodies, and the trout liked them better than the shop made varieties. We used one fly which had started as an exaggerated ' Butcher ' till the wings and hackles had been torn off and the body, now black and red with a touch of silver tinsel, used as a dropper, rivalled the more perfect tail-fly, the fish evidently taking it to be a grub or perhaps a tad-pole, of which numbers are found in shallow pools in the edges of the river.

Fish hooked in pools near white water do not play so well as in England as they ordinarily will not face the cataracts. In quieter reaches, however, they fight hard and come out of the water repeatedly. In one tributary we found grand fish, well-fed, fat and strong, which when hooked fought and jumped more than could be desired and we were never certain of landing them till the very end. At Bhuin 9 miles below Kulu town we caught a couple of small mahseer ; at the junction of the Sainj were many mahseer, the water evidently getting too warm for the trout. On the fly the largest trout caught weighed two pounds and was landed with the help of a forest guard and an apple basket. A landing net would have been more suitable ! P. got a fine three pounder on a spoon and hooked but lost larger fish. It is fortunate that in the main valley some of the inspection bungalows lie on the river as an evening's fishing is easily managed after one has returned from an inspection in the forests. Would that more of our streams in the Punjab held trout and were as capable of affording an evening's amusement as the Beas river.

ISOLATION SHOCK.

BY K. L. AGGARWAL, I. F. S.

During October 1931 when inspecting 1/4 Dungruthana Compartment I, a P.B. I. area in Inner Seraj Range of the Seraj Forest Division, I had observed that there was little seed on the mother-trees which had been opened out under seeding felling during 1930 although it was on the whole a very good seed year for deodar and there were sufficient cones on trees in the adjoining compartments. I accordingly entered

this observation in the Compartment History File of the forests. Since then the Divisional Forest Officer, Silvicultural Research Forest Division, Punjab, has written to say that it had been observed in the Lolab deodar forests, Kashmir State, that as a general rule, trees in areas recently subjected to seeding fellings produced less seed than those in adjoining compartments. This, it has been suggested, may be due to the poorly developed crowns of the mother-trees which had grown so long in a dense canopy, or to isolation shock, to recover from both of which they require time. He wanted the above observations to be confirmed or corrected by instituting observations in suitable deodar areas. The above is cited as one of the instances confirming the observations made in Lolab deodar forests.

2. As regards the cause the writer thinks that it is most probably due to isolation shock rather than to poor development of the crowns, because although on the whole it is evident that previous thinnings in this forest had neither been regular nor of sufficient intensity yet the crowns compare favourably with crowns of trees in adjoining areas. There are greater chances of isolation shock as the area is situated on a south-western aspect and is rather hot.

RATE OF GROWTH OF ELEPHANT CALVES BORN IN CAPTIVITY.

By A. K. Glasson, I. F. S.

A number of elephant calves have been born in captivity in the Andamans and some of them have survived to maturity. From the live-stock returns in the Annual Reports it has been possible to get figures shewing the rate of growth, not with any great accuracy from year to year because measurements were not taken regularly, but approximately accurate over a period of years. Combining the figures for males and females separately gives the following average results :—

Period.		0—5 years.	5—10 years.	10—15 years.	15—20 years
Growth in inches during period.	Males ..	30	15	10	3
	Females ..	25	11	7	2

Calves are about 3′-3″ high at birth.

There are of course considerable individual variations both in initial height and rate of growth. Growth in height is slow from the 20th year onwards, and generally ceases shortly after, although there may be some increment up to the 25th year.

The above information may be of use to determine the approximate age of newly acquired immature elephants. As will be seen from curves constructed with those data :—

A male 6′ high is about 5 years old.

A male 7′-3″ high is about 10 years old.

A female 5′-6″ high is about 5 years old.

A female 6′-6″ high is about 10 years old.

The hope that this information will help towards precision in a matter of more interest than importance may excuse its publication.

BURMA FOREST SCHOOL.

The annual prize distribution took place in the main hall of the Burma Forest School, Pyinmana, on Saturday, 30th April. The Chief Conservator of Forests presided over the distribution.

The Director of the School, Mr. W. G. Crawford opened the proceedings with the following address :—

Mr. Hopwood, Ladies and Gentlemen,—Before giving you a brief account of our work during the past year, I must say with what deep regret we heard of the death of Sir Lee Ah Yain, the Hon'ble Minister for Forests. For many years past, Sir Lee Ah Yain, took a keen and helpful interest in this school and on several occasions honoured our Prize Day with his presence. By his death we have lost a very good friend indeed.

The Forest School was founded in 1898 as part of the Tharrawaddy Forest Division, but was separated from the Division and moved to the present buildings in Pyinmana in 1910. This is the 22nd Prize Day in Pyinmana. Forty-seven students complete the two years' course to-day. This is the largest number so far.

The Upper or English Class, consists of six students from Burma and two from Siam. This Upper Class originally started with eleven students but three were removed during their first year. The Lower

or Vernacular Class, which is the second of the increased classes, started with forty-one students, thirty-nine of whom pass out of the School to-day. Two were removed for lack of progress in their first year. This is a great improvement on last year when only thirty completed the course out of forty who started. Of the Upper Class two have obtained the Honours Certificate and five the Pass Certificate and one failed.

The men of the English Speaking Class go out to Divisions as Probationary Rangers, and if found satisfactory at the end of two years are appointed as Forest Rangers with good prospects of promotion to the rank of Extra Assistant Conservator of Forests.

Of the thirty-nine Vernacular Class students, eleven obtained the Honours Certificate, 25 the Pass Certificate and three failed. These Vernacular Class men pass out as Deputy Rangers with good chances of promotion to the Ranger Grade.

My detailed report on the year's work has been laid before the Board of Control and it now only remains for me to comment on a few items of general interest.

The usual seven and a half months of the year have been spent in the forests. Briefly the work done by the students was :—girdling of teak over three compartments, improvement fellings in two compartments, thinning of roughly one hundred acres of teak and *pyinkado* plantations, the building of a bridge with a span of 30 feet, several large scale surveys and various minor works such as repairs to compartment boundaries, weeding in young plantations and road alignment and road repairs.

The Lower and Upper Burma tours with which 2nd year classes have in the past started the open season, had unfortunately to be cancelled owing to financial strigency and the rebellion.

The School Football XI had a very successful season. Sixteen outside matches were played, of which we won 13, lost 2 and drew 1. At the kind invitation of Mr. McLean, Head Master of the Government English School, Maymyo, and of Mr. Kay-Mouat of the Bombay Burma Trading Corporation, Limited, the 1st XI paid

a visit to Maymyo where two matches were played. The first, against the High School, we lost; the second, against a team selected by Mr. Kay-Mouat was a scoreless draw. On the way back to Pyinmana the team stopped a day in Mandalay at the invitation of Mr. Alexander of the Provincial Police Training School. This match was won by the Police Training School, but later on we had the satisfaction of beating them on our own ground here in Pyinmana.

In addition to football, basket ball, hockey and athletics, the champion section competition kept every one busy during the rains term. By making these sections as even as possible keenness and interest were well maintained throughout. Mr. Edgerley again ran the boxing, though no tournament was held as there were too few entries. Both the staff and the students owe Mr. Edgerley a debt of gratitude for the keenness and efficiency with which he has run all our sports and carried out the arduous duties of House Tutor.

The certificates, medals and prizes were then distributed to the successful students of the 1930-32 course by the Chief Conservator of Forests.

Mr. Hopwood, Chief Conservator of Forests, then made a speech from which the following is quoted :—

I need not say what a joy as well as an honour it is to be here to-day to present the medals and certificates to the students. It is always a great pleasure to come to Pyinmana and it always has been a pleasure, but to-day I confess that I find it a tonic. At Pyinmana I find everything full of life, vigour, energy and progress ; that is a very remarkable thing. I travel a good deal about Burma and the more one goes about Burma, the more remarkable one finds it, because there is a great deal of depression ; in places almost complete inertia and despair. There is nothing of that at Pyinmana. Here there is ambition and keenness. How keenly the privilege of becoming a student at the Pyinmana Forest School is valued was shown last October when the students were selected. One of the tests was a walk of 20 miles. Many of the candidates arrived at Pyinmana several days before the day of selection in order to practice this walk, so that they

should not be rejected on this account. When the test came, although only required to walk, many of them ran the whole distance. Though there were only ten vacancies, no fewer than 173 candidates offered themselves, all of whom had passed the High School Final Examination. This shows how the attitude of the Burman towards a life in the Forest Department has altered. A few years ago there was great difficulty in obtaining educated candidates for Forest Department posts. We live in a world of change. This last generation has seen greater changes than have occurred in any of the preceeding generations. Our greatest difficulty as a department lies in adapting ourselves to these changes. Pyinmana has made great progress in the last 30 years. Now one sees the Forest School with its magnificent buildings and its museum to which last year nearly 10,000 people paid a visit, there are now three bridges spanning the Ngalaik stream and luxurious motor cars and motor buses driving about on the splendid roads.

There is not very much wrong with the Forest Department, when its officers send their sons into the same service. At this school to-day one of the students is a son of a Forest Ranger and one is a son of a Forester. As usual we have four students deputed by the Siamese Government and as usual they have given very great satisfaction. Two of them are passing out first and second with honours.

REVIEWS.

FAUNA OF BRITISH INDIA : COLEOPETRA, LAMELLICORNIA, PART III, COPRINAE.

BY G. J. ARROW.

The difficulty of identifying the vast majority of Indian insects is not generally appreciated. Descriptions of many have been published in a large number of scattered and often inaccessible scientific journals and in many languages. Then, even when the so-called description has been secured, it too often proves to be grossly inadequate. This is where the " Fauna of British India " volumes are so important; all that is known of the species of a particular family is collated and new and adequate comparative descriptions are made by a specialist. Mr. Arrow's present volume on the *Copridae* is one of the finest that has yet appeared; only a systematist can appreciate, perhaps, the vast amount of labour and patience involved in producing a work of this kind, where a great number of species, and usually many specimens of each species, have been subjected to critical examination. There are a beautiful coloured plate and numerous excellent text-figures, while a number of photographs taken by Mr. Arrow himself prove him a finished photographer.

The family as is well known consists for the most part of beetles which concentrate on the removal, for their own purposes, of dung from the earth's surface; their scavenging efforts deserve man's greatest respect. A most interesting introductory summary of the habits is given in this volume.

The collection of dung-beetles, especially in the hot climate of India, is not of the most pleasant kind and it says much for the stern sense of duty of workers at the Forest Research Institute, that Mr. Arrow has found our collections of great use to him in writing his book.

J. C. M. G

TREATMENT OF BABUL (ACACIA ARABICA) IN BERAR.

BY S. A. VAHID, I.F.S., INDIAN FOREST RECORDS, VOL. XVII, PART II.

This account of the *babul* forests of Berar has been delayed since 1928 in publication, but is none the less welcome as an indication of the progress in our knowledge of this very useful species since the issue of Troup's *Silviculture of Indian Trees*. From the pages of the *Indian Forester* a layman might easily be led to think that we had only three species of tree in India, for we hear much of *sal*, deodar and *chir* pine, and too little of the multitude of other equally interesting but less chronicled species. We are therefore glad to call attention to this careful summary of local experience with *Acacia arabica* by Mr. Vahid.

The scattered *babul* forests of Berar are closely hemmed in by cultivation and are absolutely invaluable to the extremely poor class of peasantry in supplying timber, fuel and grazing grounds. A further value has been added since the regeneration of these forests was standardised under a system of *taungya* which allows for 5 to 7 years cultivation of field crops during each forest rotation of 25 years. The yield of cotton obtained from these *taungya* crops is so much heavier than from the perennial farming of unmanured ground that the 5-year cultivation leases are much sought after. The pamphlet contains a detailed study of the management of these leases and of the silviculture of the species, which as a strong light-demander flourishes under the *taungya* regime provided thorough weeding and frequent thinnings are attended to. The only successful mixtures so far have been to include a percentage of *Azadirachta indica* (*nim*) and *Gmelina arborea* amongst the *babul*.

R. M. G.

PROGRESS REPORT ON FOREST ADMINISTRATION IN THE PUNJAB, 1930-31.

The report under review contains much that should be of interest both to the general public and to forest officers. A review of the area administered by the Forest Department shows that out of a total of 3·39 million acres only 0·69 million acres, roughly one-fifth, can

be classed as merchantable forest and this includes large areas of fir which at present cannot be worked at a profit. Of the balance nearly 1 million acres are either inaccessible or can only supply local demands, mainly those of right-holders: 0·5 million acres consist of scrub, valuable as protection forest, and for grazing and firewood: 1·14 million acres are waste land which includes the alpine pastures which provide rich summer grazing for the thousands of sheep and goats which come up from the low hills. Irrigated plantations occupy only 0·05 million acres.

The true economic value of this forest estate cannot be tested by comparing the bare figures of revenue and expenditure. The majority of the Punjab forests are situated in the catchment areas of the great rivers which supply water for the irrigation schemes which extend throughout the province and beyond; they are therefore, before all things, protection forests, and their management is largely directed to serve that important object. Again many of the forests are heavily burdened with rights and, as the Chief Conservator points out, the value of free grants and concessions in the Punjab is many times greater than in other Provinces in India. It is in the light of such considerations that the working of the Department must be judged. The year under report showed a deficit of over Rs. 4 lakhs, as compared with a surplus of Rs. 1·88 lakhs in the previous year; this is attributed mainly to world-wide trade depression in general, and to the heavy decline in prices of timber in particular: the revenue from major forest produce was nearly Rs. 5½ lakhs lower than in the previous year. The value of forest produce given away to right-holders is estimated at Rs. 24 lakhs which is not taken into account at all.

The Working Plans Circle was occupied with a full programme and much of the arrears which had accumulated, largely as a result of the Great War, must have been worked off. An innovation in the report is an appendix which shows the progress of natural regeneration under systems of concentrated regeneration under a shelterwood for working plans in force. Figures are given by working circles and for principal species. The statement has presumably been compiled from

control forms and, as is admitted in the Administration Report, where regeneration is mainly natural, a year to year comparison may not be of great value in testing the progress of regeneration, but it provides figures to show whether the general rate of progress is satisfactory or not ; in addition, the collection of the necessary figures by the divisional staff will produce much data which should be of great value when working plans are revised.

The report again draws attention to the serious consequences which may result from the excessive grazing going on in the low hill forests. The entire destruction of these forests and the adjacent cultivation is envisaged unless early action is taken to restrict grazing, while evidence is not lacking to show that the denudation of the slopes is beginning to have an adverse effect on the flow of water in the larger rivers. Reports have been made to Government on the grazing incidence in certain localities and an Erosion Committee has been formed to consider what measures can be taken to preserve these forests from destruction. Education by propaganda is essential but it will be many years before the *zamindars* concerned can be persuaded that it is necessary, even in their own interests, to restrict rights which have been enjoyed by their ancestors for centuries and the Committee will have to be prepared to recommend the immediate inauguration of measures which will certainly be very unpopular and which may, at first, be expensive. But a broad view of the whole issue must be taken ; and it must be realised that the continued success of irrigation in the Punjab is intimately bound up with the protection of the hill forests. Lakhs of rupees are spent annually on irrigation and improvement of agriculture : it would be false economy to deny the expenditure of a sum of money, small in comparison, to counteract an influence which is slowly but surely undermining the good work on which vast sums have been spent.

A Silvicultural Research Officer was appointed in September 1930. He supplies a long-felt want and there will be much for him to do. A triennial programme of research work has been drawn up, and the measurement of sample plots will be taken over from the Forest Research Institute.

Important results have attended investigations into the best methods of irrigating plantations; they show that shallow and frequent irrigation is preferable to deep irrigation. In this way less water is required to raise a plantation, and it has been found possible to raise *shisham* cuttings on *kallar* soil where previous efforts had failed.

A. P. F. H.

ANNUAL FOREST ADMINISTRATION REPORT FOR BENGAL, 1930-31.

No review of Bengal's report for 1929-30 has appeared in the *Indian Forester* as the editor was unfortunate in his choice of victims and nothing fit for publication was evolved! This is to be regretted, as many of the recent developments in Bengal are well worth chronicling. We are now dealing with 1930-31.

To start on a truculent note, the price of this publication, Rs. 4/8/-, seems to be too much, considering that the standard of the photographs reproduced is definitely poorer than that of the previous year, and apart from two good pictures of *Cryptomeria* are not worth reproducing.

To get the distasteful medicine of financial gloom disposed of, we must record a drop of Rs. 7·40 lakhs in the provincial revenue and of Rs. 6·68 lakhs in the surplus compared with the previous year. The drop in revenue is shared by all divisions except Darjeeling, Chittagong and Cox's Bazar, and is worst in the Sundarbans. The output of timber dropped from 145 to 111 lakhs cubic feet in South Bengal and from 18 to 13 lakhs cubic feet in the Northern Circle. The heaviest drop amongst the individual timber species is in *gengwa* (*Excaecaria agallocha*) in the Sundarbans, but the available supplies of this timber are very limited, and even at the present reduced rate of exploitation it is rapidly becoming exhausted. The serious drop in the output of *sal* timber is inevitable, for apart from the trade slump altogether, it is recognised throughout Bengal that the extensive use of reinforced concrete and metals in city buildings has already usurped the heavy structural timber market.

In view of this latter development, the policy of the department must obviously lie in encouraging the trade in luxury timbers, furniture goods, and the lighter and cheaper types suitable for boxes, crates, casings and other temporary and small-wood markets. The many interesting silvicultural developments in North Bengal are in line with this change, and the area of mixed plantations of valuable furniture woods and quicker growing box woods now amounts to over 22,000 acres; truly an amazing achievement when the difficulties of the country, the climate and the aboriginal *taungya* labour are realised. For the first time in the history of this *taungya* work progress was limited to the area which could be dealt with under fellings curtailed by market conditions, as previously the limiting factor has always been the scarcity of labour for the *taungya* work. In the five divisions of the Northern Circle an average of 36 per cent. of the area prescribed for *taungya* in the current working plans is being dealt with.

Interest in natural regeneration has not been dropped, however, and it is hoped that by the application of the "Assam method" of repeated burnings a large area in the waterless Raimatong forests will eventually be naturally regenerated with *sal*, while elsewhere on the dry ridges of the foothills the scientific application of burning is being used to extend the *sal* by felling and burning the other species in likely places.

The tending of young woods is also receiving much attention in North Bengal. Observation of the climbers which are so destructive to young *sal* shows that these weeds establish themselves in the third and fourth rains after the *sal* has sprouted, though the damage of deformed stems is not in evidence until later. Cutting them back has very little effect and work is now being concentrated upon uprooting them in the early years of plantations, as it is anticipated that this will in the long run be cheaper and more effective than continued cutting back. The problem is an important one as at present cutting back is done over some 40,000 acres annually and costs average 6 annas per acre. An intensive study of climbers is being made in Kurseong

Division and we hope soon to be able to publish an article by Mr. Davidson on this interesting sidelight on silviculture.

Experiments on the best procedure for burning and thinning young *sal* plantations are also being carried out to reach a definite decision on these questions. At present it is thought that thinnings should be delayed until the eighth year as *sal* has a marked faculty for sorting itself out, the trees of the future going ahead in both height and diameter growth whether they are assisted by thinnings or not. The early burning of *sal* plantations of 8 years old appears to do no harm, and in fact more damage is done in crops of 10 years or more, as these come into leaf sooner and therefore have to be burnt earlier in the season than younger crops.

In South Bengal also a certain amount of experimental silviculture is going on though no large areas can be taken up for regeneration work until extraction has been made easier with better roads and communications. *Taungya* work in the Kaptai area of the Chittagong Hill Tracts is yielding good results with teak and *Gmelina* as the principal species, and in Cox's Bazar the 1928 plantation of *garjan* (*Dipterocarpus turbinatus*) is now well established though the natural regeneration of this and other *Dipterocarps* is still problematical owing to the great quantities of seedlings which die off. It is thought that the shade factor is responsible for this, and experiments are being made in several places to check the effect of shade, both by manipulating the tree canopy over natural regeneration and by pruning *boga* (*Tephrosia*) in plantations. Underplanting of teak is also being tried with *tali* (*Dichopsis polyantha*), *kamdeb* (*Calophyllum polyanthum*) and *Swietenia macrophylla*.

As regards working plans North Bengal is in the fortunate position of having all her revisions either sanctioned or drafted, so that no revisions will fall due for the next three years. In South Bengal the Sundarbans revision is still being worked out, and we hope to publish shortly an account of the changes in management which are being introduced in this highly specialised forest area.

Under exploitation and engineering work, the Siliguri sales depot shows a marked reduction in sawing costs from 11·20 to 8·71 annas per cubic foot. This has not been brought about by the introduction of fresh machinery but is due to careful reorganisation on the evidence of previous costing statements, and shows what can be accomplished by attention to detailed depot management. The skidding machines which were previously in use in the forest areas of Sukna and along the Darjeeling Road are now in regular use for marshalling logs in the sale depot itself, making order out of the chaos of bullock cart deliveries. The introduction of an electric overhead travelling crane has had to be postponed.

The *Terminalia tomentosa* timber lying in London was sold at a good price, and there appears to be a good future for this wood in the home market. Unfortunately the price of this timber varies enormously according to whether it is figured or plain, and it is difficult for the ordinary forest officer to tell the difference even in squared logs. Until this can be done, the entire profit on well figured pieces will go to the middleman, and we would strongly urge the need for employing a timber specialist to sort out the more valuable pieces before big lots are disposed of, as the difference in price is somewhere in the neighbourhood of Rs. 15 per cubic foot.

Amongst new buildings may be mentioned a new Divisional Forest Officer's headquarters bungalow at Jalpaiguri and a forest rest-house at Bengdubi in Kurseong ; the latter is an exceedingly useful and workmanlike type of building for this part of the country and incorporates most of the good points from previous bungalow patterns.

The persistent poaching of rhino in Buxa Division is referred to elsewhere in this number, and it is sincerely hoped that more effective and stern measures will be taken immediately to stop this savagery. Unless something is done quickly the rhino will be completely exterminated from the Bengal forests and another of our cherished links with the primeval forest will be gone. The rhino horns fetch well over Rs. 1,000 each and are apparently exported to

China for use as an aphrodisiac. Another example of uncontrolled slaughter of animals is in the Calcutta trade in monitor lizard skins: during the previous year some three million skins were exported, valuing over Rs. 50 lakhs, and now that the supply is becoming difficult the smaller animals such as the large water lizard (*Veranus salvator*) are being persecuted. For the latter the department received revenue of about Rs. 10,000, but whether the department profits or not, something should be done by the responsible authorities to prevent such insensate slaughter.

R. M. G.

EXTRACTS.

Eneroth, Olaf: " The Locality's Inviolable Law," *Svenska Skogs-Vardsforeningens Tidskrift*, vol. iv., 1931. 44 pages.

The writer continues the extracts from his report on a visit to Germany, the first of which appeared in vol. i., 1931. The two forest areas dealt with in this issue are: II. Eberswalde, and III. Hohen-Lubbichow. In the Eberswalde district special attention was paid, in the first place, to the tolerance of young pine on soils of different structure, and secondly, to the correlation between quality-class and the geological character of the soil. The importance of these studies lies in the fact that the possibility of using the shelter-wood system of natural regeneration depends on the tolerance of the young plants, while the importance of the second study is its bearing on the question of how far we can alter quality-class. The Eberswalde district is covered with various types of glacial deposits, and presents a variety of soil conditions for such study. The writer recognises three types of pine regeneration, namely (1) a satisfactory type where the pine does not suffer from the oppression of mother trees and where the death-rate is reasonable; (2) an unsatisfactory type on soil much overrun with grass—most of the pines die and the few survivors grow poorly; and (3) an unsatisfactory type on dry but not grass-grown sand. The death-rate here is not specially high, but the growth of most of the plots is extremely poor. The writer seeks to relate the conditions in these types to the physical texture and layering of the soil, and suggests that the silvicultural treatment may require modification on that account.

In discussing the second subject of study a good deal is said about Hartmann's ecological studies in the N. German pine of the relations between climate and soil, of the effect of climate on soil formation, and on estimations of humidity based on total precipitation and evaporation. The evaporation figures are derived from the difference between total rainfall and stream flow in various watersheds in Sweden.

Different methods of reckoning the climatic humidity are discussed, and maps of Sweden have been prepared showing the relative humidity based on Lang's humidity factor and De Martonne's humidity factor. The former is based on the formula, mean annual rainfall over one-twelfth the mean temperature of the months which are free of frost; the latter on the formula, mean annual rainfall over the mean annual temperature plus 10. The maps are of considerable interest and more useful than the ordinary rainfall maps when it comes to the study of soil and vegetation types. On the basis of the maps Hesselman divides Sweden into a number of humidity areas or zones. De Martonne's formula is recommended as being a satisfactory one. It would be an interesting exercise for someone to prepare a similar map of Scotland.

(*Scottish Forestry Journal, March* 1932.)

DERRIS ROOT.

BY H. S. MALIK, ESQ., I.C.S., DEPUTY INDIAN TRADE COMMISSIONER, LONDON.

The note is an attempt to show the position of *Derris* root in the United Kingdom with special reference to India as a possible source of supply. The information has been collected as a result of enquiries from dealers and from Research Stations in the United Kingdom and from official sources in India.

The commercial value of *Derris* root lies in the fact that certain known species have a definite insecticidal value. Research work on this point has been going on for some time, and has shown that mainly on account of their Rotenone content *Derris elliptica* and *Derris malaccensis* have definite insecticidal value, the toxic properties being apparently confined to subcutaneous portions of the root. Another species, *Derris uliginosa*, has also, on one occasion at least, been tested in the United Kingdom when it was found to have practically no insecticidal value. This test was not, however, conclusive and further investigation is necessary before *Derris uliginosa* can be definitely condemned as unsuitable.

The trade require fine roots of *Derris elliptica* or *Derris malaccensis*. It is emphasised that coarse roots are of much less value than the fine roots. Another point to be noted is that the root must be absolutely dry before it is shipped so as to eliminate as far as possible the risk of attack by mould. There is at present a keen demand for *Derris* root of suitable class and quality.

As a result of an enquiry received from the London Chamber of Commerce on behalf of a firm desirous of importing *Derris* root from India, the Indian Trade Commissioner, London, ascertained by enquiry from India that at present there is no regular trade in *Derris* root with that country. It was further ascertained that *Derris elliptica* was found in Burma but nowhere in India proper. In Burma too it did not appear to be grown at present in commercial quantities. The position with regard to *Derris malaccensis* in India is obscure. *Derris uliginosa* is found in Chittagong, Central Bengal and the Sunderbans. As explained, however, in an earlier portion of the note, the question of the insecticidal properties of this species requires further investigation.

The position, therefore, appears to be that India does not at present grow those species of *Derris* which are known to have reliable insecticidal value. If cultivation could be developed, a ready market could be found for this product in Europe.

It is hoped, therefore, that it will be possible to carry out investigations in India and particularly to ascertain :—

(1) Whether India can grow *Derris elliptica* and *Derris malaccensis* in commercial quantities.

(2) Whether *Derris uliginosa* or any other species of the root found in India has sufficient Rotenone content to give it commercial value as an insecticide. In this connection it should be noted that *Derris elliptica* and *malaccensis* have a Rotenone content of anything up to 6 per cent, an average sample having about 2 per cent, while *Cube*, a Brazil plant which is being used largely in America for insecticide, has a Rotenone content of anything up to 7 per cent.

(*The Indian Trade Journal*, *March* 31, 1932.)

LAND EROSION IN INDIANA CHECKED BY FORESTATION.

Erosion of land occurs to a serious extent in many agricultural states, and its prevention and correction is largely an engineering problem. How this problem is being solved by forestation in Indiana was described in a paper read at the recent meeting of the National Drainage, Conservation and Flood Control Congress, by R. F. Wilcox, state forester, and S. R. Sapirie, field engineer, of the Indiana department of conservation. The accompanying view (*not reproduced*) shows a condition which in miniature resembles the "bad lands" of the Missouri and the vast eroded areas of China that have resulted from destruction of the forests. An abstract of this paper follows.

To determine the average loss of soil per acre by erosion, cross sections were taken on a field in the state forest of Morgan and Monroe counties. These showed a loss of 11,580 cu. yd. per acre, or an average depth of 7·17 feet. This field has not been in cultivation for 45 years and had a fairly uniform slope of 10·8 per cent. at the time of its abandonment for agriculture. From an aerial map of the forest taken at 9,600 ft. elevation it was found that 295 acres showed erosion plainly. Taking 50 per cent of the extreme case measured, or 5,790 cu. yd. per acre, the soil loss on the eroded area has been 1,708,050 cu. yd., or enough to cover a square mile 1,656 ft. deep. All the runoff from the test area has poured through a narrow channel on a forested hillside, with no erosion on either side, as the trees, shrubs and herbaceous plants have formed a protective blanket.

Forestation to check erosion was tried in the Clark County forest in 1910 on a gullied slope of about 15 per cent bare of vegetation and about 40 ft. long. Brush was thrown in the ditches and spread over the surface. Black locust trees were planted about 6 ft. apart. Three years later the brush had rotted away and the trees were about 10 ft. high. In 1920 the trees began to show the effect of the locust borer insect, and the area was underplanted with white pine, which grew vigorously, as the locust had protected the soil and envigorated it with nitrogen and leaf humus. Native shrubs and vines grew in a similar manner, so that in 1932 there is a complete stand of thicket and forest trees that has completely stopped every trace of soil erosion for the last several years.

With this experience as an object lesson, a crew of men worked for months at the Morgan-Monroe forest, filling gullies with brush and planting black locust seedlings and pines on the eroded fields. Locust seedlings one year old can be grown at a cost of 2 dollars per thousand by planting the seeds ¼ in. deep in garden beds about May 20 to June 1. One or two weedings in the summer are all the culture they need. The cost of planting the trees is about 5 dollars per acre. Trees cost 2 dollars and the brush cover costs about 5 dollars, making the cost of control about 12 dollars per acre of gullies.

(*Engineering News-Record*, 31-3-32).

[12 dollars per acre at the current exchange represents about Rs. 40.—Hon. Ed.].

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THE PROGRESS OF FORESTRY RESEARCH.

The report of the Seventh Spike Conference printed in this issue again brings to notice the slow but steady progress which is being made in grappling with the problem of the "spike" disease of sandal, an affliction which is doing incalculable harm to the sandal-wood industry. Sandal is one of the major forest products throughout Southern India, and the value of the trade in this precious timber runs into some 30 to 40 lakhs of rupees annually, apart from the market value of the sandal-wood oil which is manufactured from it. Most of the sandal-bearing forests are affected by this spike disease, whose presence reduces the sandal output by about half, and in many places has entirely killed out valuable sandal crops. The direct commercial implications of this pest can be grasped at once, but so far no cure for it has been found, and it is only through a broadly planned programme of research work that some definite progress has recently been made towards isolating and recognising the cause of this mysterious affliction.

The issue is complicated by the facts of the case, namely that sandal itself is a parasite and cannot flourish without a tree of some other species to act as its host; that the spike infection may be spread by one of many different things, *viz.*, insects, fungi, root contact, fire damage, some virus poison, or merely some physiological condition of ill-nourishment or suppression; also, that the disease may not have any obvious effect upon the tree until long after the attack has begun, so that its spread cannot be seen and checked in its early stages.

From all this it is obvious that the problem can only be solved by team-work, for no single man can grapple with the many subjects such as entomology, mycology, parasitology, soil science, botany and silviculture, all of which are involved. It has to be tackled from its broadest ecological basis by a careful analysis of the whole life-cycle of the sandal tree from the seed upwards, its relations with its plant associates, and the complex inter-actions of the wild and domestic animals, birds, insects, and soil agents of these sandal-bearing forests. Such team-work has to be very well organised, and the various specialists must work together in a spirit of absolutely unselfish co-operation if the knowledge gained by each is to bear fruit in a common advance.

The spike disease of sandal is only one individual problem of management in the vast field of our Indian forest estate. The government forest estate covers the huge area of 160,000,000 acres, apart from the 45,000,000 acres of forest in Indian States and an even larger area of private and village forest lands. Of the 160 million acres directly under our control only half is commercially productive, while the other half is conserved for the use of right-holders or is protected as an insurance against floods and erosion. In spite of half of them being unproductive, the revenue from our forests has been steadily increasing. In 1870 the revenue was Rs. 70 lakhs and the surplus was Rs. 17 lakhs, while sixty years later in 1930 the revenue had grown to over Rs. 6 crores and the surplus to Rs. $2\frac{1}{2}$ crores.

The figures for 1929-30 show that although the surplus amounts to Rs. 105 per square mile, the nett cost of the research work carried out by our Institute, namely Rs. 9 lakhs excluding the cost of education establishment, works out at Rs. 3·6 per square mile, which does not appear to be an exorbitant sum for a key industry to reinvest in its own development. Forests are essentially a national asset and the two-fold object of our stewardship must be to produce a reasonable revenue while preserving and improving their productive capacity. This can only be done by a systematic programme of research work aimed at improving our growing stock and developing our markets. The basic sciences of silviculture and forest protection in its widest

sense must be dealt with as fully and as liberally as the more obvious lines of timber research although they may not yield such immediate and spectacular results.

W. J. Abbot writing in the *Christian Science Monitor,* one of the most widely read and influential daily newspapers says : " In the Department of Commerce (of U. S. A.) are a large group of scientifically trained men whose task it is to aid in the development of American trade, in the discovery and utilization of raw materials, in the development and exploitation of the natural resources of the country. To cripple their service at a time when business and industry in the United States are at their lowest ebb is something like denying food to a starving man by way of restoring his strength." If this is applicable to a highly developed country such as the United States, surely it is apposite in the case of India with her enormous reserves of undeveloped natural resources, and particularly her forest wealth.

A FLIGHT OVER THE ANDAMANS.

By A. D. B.

I am indebted to Wing Commander Wright, R.A.F., Singapore, for taking me for a flight over the South Andaman, Baratang and Long Islands and back to Port Blair on the 16th December. I was particularly anxious to see whether it is possible to recognise from the air the extent, and possibly the effect, of past unregulated fellings, and also to ascertain whether the several types of forest are recognisable. The flight was exceedingly interesting and suggested great possibilities of employing aerial observation and photography as a quick and economical means of obtaining information about selected areas of forest. In the course of two hours including a descent for a few minutes off Spike Island we must have flown in the neighbourhood of 150 miles and, throughout, many of the large variety of trees and the varying density of the forest were recognisable. The success of the Wimberleyganj plantations on the western slopes of Mount Harriet Range was very obvious. A little further north striking

features were the immense area of virgin forest on the Cholunga and West Coast Ranges all of which is occupied by the wild " Jarawa " tribe, and the expanse of mangrove forest. South of Homfray Strait there appears to be little of the large mangrove, *Bruguiera gymnorhiza*. We passed over Adajig Camp where fellings are still in progress ; the surrounding forest showed evidence of the operations, but I was unable to record details on this my first aerial inspection. As we approached Long Island the plantations of recent years were visible ; I knew them to be a success as a whole from my inspection in January, but owing to our distance, the smallness of the trees and the heavy growth of *Eupatorium* I could not confirm this from the air.

Returning south along the east coast it was evident that the lower slopes of Mount Harriet Range had either been depleted to some extent of large trees, or did not bear as dense forest as most other areas.

Throughout the flight I had some difficulty in distinguishing the evergreen from the deciduous forest. It is recorded in the Working Plan that the types of forest are very intimately mixed and the changes from one to the other unexpectedly sudden. This accounts for my difficulty even when individual trees where identifiable beyond doubt, but to a forest officer more familiar with the forests, or in a month or two when more trees have shed their leaves, it should be possible to define the extent of these two types very fairly accurately. Most of the forest is very dense and inspection on foot a slow process.

In spite of the limitations of what I was able to observe there can be no manner of doubt of the value of aerial observation in regulating fellings in the Andamans forests. Such observations, whether recorded by sketches or photographs, cannot entirely replace the enumeration of trees, but they would help to indicate the areas to be enumerated and confirm the application of partial enumerations, which are so very much quicker and less expensive than complete enumerations. Again topographical details, which are so important in the economical extraction of timber and yet so roughly shown on existing maps,

could be recorded with infallible accuracy. The sinuous courses of many creeks I saw were remarkable, and reefs and shoals were amazingly clear. In present financial conditions an aerial survey of all the islands is impossible, but photographs of selected areas would greatly assist the preparation of a working plan or scheme and considerably reduce the cost.

THE UTILITY OF CACHAR BAMBOOS.

By A. K. Adhikari, P.F.S.

The *muli* (*Melocanna bambusoides*) and *dolu* (*Teinostachyum dullooa*) are the two most common and useful bamboos of Cachar Division. The former is more plentiful than the latter and not being a clump bamboo it propagates more freely from its rhizome and grows practically throughout the district on exposed slopes and tops of hills, whereas the latter being tufted is less mobile and is mostly confined to damp cool valleys, where it grows to a large size. Although we have a demand for this most plentiful *muli*, we could easily supply more. In the Jatinga Valley all the old *jhums* have now filled up with pure *muli* and it is no exaggeration to say that the *jhums* have joined up so completely that a fine pure belt of *muli* is now seen running parallel to the Assam-Bengal Railway from Harangajao to Jatinga on both sides of the Jatinga River. This belt alone could keep going a paper pulp factory, if it were not for the fact that the railway freight on chemicals and coal on the Hill Section proves a barrier. If, however, the bamboos, instead of being railed out to Calcutta, were booked to the bank of the Barak, Badarpurghat, and the chemicals and coal imported by river steamer, that would be a happy compromise, and the installation of a paper-pulp factory would be possible, with both river and rail transport within economic reach. Rafting of bamboos down to Calcutta has proved impracticable in the past.

Nature has provided plenty of water-ways in this part of the country and at the same time she has grown bamboos side by side to float her heavy timbers. It is for this reason alone that timbers from

Lushai and Manipur Hills could find their way to the markets of East Bengal and Surma Valley,—travelling often distances of three to four hundred miles—all due to the buoyancy and durability of *muli* and *dolu*. The bamboo floats, called "*bungas*," are usually bundles of 200 bamboos, placed on either side of the logs, with cross poles called "*guras*" to suspend the logs from. Enormous logs can be carried by these floats. Individual logs tied with floats travel down uncontrolled and are caught by the boom : simple thick coir rope or cane rope thrown across the river serves the purpose. From here they are made into big rafts with 100 to 200 logs and taken down to the different markets of Surma Valley and East Bengal. The one seen in the photo is on its journey.

These bamboos are used for various other purposes from house roofing to trapping of jungle fowls. Several lacs of bamboos are sent out to other parts of Surma Valley and East Bengal from this Division annually.

The cost of rafting, as usual in river transport, is very cheap. It is the cost of extraction from the forests to the banks of the nearest floating streams that decides to what depth the forest can be tapped. It has been found that with elephant haulage economic working, generally speaking, is possible in Cachar, Lushai Hills and Manipur within an average depth of a mile from the bank, as often the banks are too hilly to permit of tapping any deeper. The single rafts often come 70 to 80 miles before they are caught by the boom. It is obvious that the distance of uncontrolled rafting makes no difference in the cost and it is for this reason that timber from Manipur States can compete equally with Cachar. The cost of extraction per cubic foot up to Soni and Sealtek, from whence they are sold to traders of Bengal and Sylhet, is generally Re. 0/3/0. The distance of controlled floating is the thing that matters. There is practically no conversion in the forest and the entire stock is brought in log form and sold as such in floating condition.

Bamboo rafts are used to float heavy logs from the Lushai hills.

THE SHOLAS OF PALGHAT DIVISION; A STUDY IN THE ECOLOGY AND SILVICULTURE OF THE TROPICAL RAIN-FORESTS OF THE WESTERN GHATS.

PART II.

BY T. V. V. AIYAR, P.F.S.

11.—*Silviculture in the Rain-Forest.*

It may at first be surmised that growth in the tropical rain-forest would show no periodicity and that if it did show any, the months of June to September, when the south-west monsoon spends its full fury on these hills, would be the period of highest growth activity. This does not appear to be the case, however.

An unbroken cover of heavy clouds precipitating incessant showers of rain at an average rate of two inches in twenty-four hours, preventing even glimpses of the life-giving sun and stifling the soil from receiving its due share of air, are conditions scarcely conducive to vegetative activity. No young leaves are put forth in this season and few flowers bloom. Seeds which have fallen with the advent of the monsoon either lie dormant or the young seedlings limit their activity to sending their roots down into the soil, a very necessary anchorage against being washed away by the torrential rains. Seeds of *Palaquium ellipticum* fall with the south-west monsoon and germinate directly, indeed they often germinate on the tree before falling, but the seedlings develop their roots and only the first pair of leaves during the rains. *Mesua* seeds also fall in May-June but often do not germinate till September. *Heritiera papilio, Cinnamomum zeylanicum, Scolopia crenata* and a host of others have been observed to behave in a similar manner.

The months of September and October, when the rain abates and the light of the sun streams in, mark the commencement of vegetative activity. Tender leaves are much in evidence and so are tender young plants sprouting from their seeds. The landscape gradually takes on masses of variegated colour, the white and pink of *Mesua ferrea*, the violet of *Poeciloneuron indicum* and the mango, the red and crimson of *Nephelium longana* and *Cinnamomum* sp. These are but the prelude to the season of blossoms, which commences in November (with *Cullenia excelsa, Acrocarpus fraxinifolius, Symplocos spicata,*

Gordonia obtusa and *Elaeocarpus serratus*) and continues till the arrival of the south-west monsoon. The process is prolonged over a series of months on account of the multiplicity of species and the equability of the climate, unlike that of the temperate zone where the advent of spring ushers in an almost explosive vegetative activity.

Even during the monsoon, however, the dominant trees must be utilising what sunlight filters through the clouds, and laying by stores of food material for their future activities after September, but the conditions are obviously much more adverse for seedlings and other ground-flora.

It will therefore be apparent that the season of growth in these forests is from September to June. There is little danger for young seedlings from drought, as the humidity remains high during this period and is periodically augmented almost every month by occasional showers.

The special silvicultural characters exhibited by a few of the most important timber trees of this formation may now be noticed.

MESUA FERREA.

This is the most economically important species, as the Railway Companies pay well for sleepers made from this tree—in fact its demand at present is limited to sleepers. Two varieties are met with, one with distinctly larger flowers and fruits than the other.

The species occurs between the elevations 2,500′ and 4,500′ (though a specimen has been observed at Cochin on the sands of the West Coast) but grows to its best size between 3,000′ and 4,000′ under rain-forest conditions on deep, fertile, well-drained soil. It does not tolerate marshy conditions or stiff clay and is therefore rarely met with in reed associations. Under the best conditions it occurs scattered or in more or less pure patches of small extent, but the tendency towards gregariousness is well marked where the soil is inclined to be rocky or at elevations above 3,750′, where it is in the *Mesua-Palaquium* association, or at lower elevations where the climatic conditions are not the optimum for *Palaquium* or *Cullenia*, as in the Anangan-thodu Valley of Attapady Block 1. It is found associated

with *Calophyllum elatum* on ridges and on the margins of *sholas* adjoining grass-land, where better light conditions prevail and where there is little competition from strong shade-bearers like *Palaquium ellipticum*.

The incidence of *Mesua* in these two associations is given in the following table for different diameter classes. The figures are from enumeration data :—

Diameter-class.	12″-16″	16″-20″	20″-24″	24″-28″	28″-32″	32″-36″	36″-40″	Over 40″	Total.
Cullenia-Palaquium.	0·8	0·8	0·7	0·6	0·3	0·2	0·1	0·3	3·8 trees per acre.
Mesua-Calophyllum-	2·2	2·2	2·0	1·5	0·9	0·5	0·3	0·3	9·9 trees per acre.

Leaf-shedding, Flowering, Fruiting, etc.—Old leaves fall from October and the pink-and-white young leaves appear on young seedlings from the same month, though on older trees fresh leaves sprout only in January-February. The snow-white flowers appear from February to May usually, but have been observed as late as August. During these months the floor is strewn with the white petals. The fruit ripens usually in April-May ; unripe but full-grown fruits have been picked up in February, probably the result of August blossoms. About 100 to 150 seeds go to the pound.

Silviculture.—*Mesua ferrea* is a shade-bearer when young but less so than its associates *Palaquium* and *Cullenia*. The tree seeds almost every year and bumper crops are frequent but the seeds are eagerly sought after by rats, mouse-deer, porcupine and other vermin, which also destroy a large part of the seedlings for the sake of the cotyledons. Fences round nurseries and dibbled patches in the forest have been found to give effective protection against these in Tinnevelley. Careful selection of the ripe fruit at the right time is essential for good results. The time depends on the previous flowering season

and is usually April-May, but if the fruit is deep-brown and shows signs of dehiscence it may be considered mature. The ground below the mother tree should be swept clean and only the heavy fruits fallen over night and of the description given above should be collected. With such seeds over 50 per cent. should germinate.

Seeds sown in June have germinated only in September and it appears to be the rule for naturally fallen seeds to germinate similarly. They appear to keep their vitality, therefore, for four months at least and dibblings in September are likely to suffer less from vermin than those made in June. Natural regeneration occurs under shade, but dense undergrowth is detrimental to development and high shade appears to afford the best conditions for establishment.

In *Cullenia-Palaquium* or *Palaquium-Mesua* associations the natural regeneration of *Mesua* is under a heavy handicap. *Palaquium* and *Cullenia* are heavier shade-bearers than *Mesua*, as might be inferred from their comparative leaf texture, while both seed profusely almost every year and their seeds are less liable to damage. They exhibit therefore a greater tendency to gregariousness in these types of forest than *Mesua*. The ground in the vicinity of *Palaquium* is literally carpeted with natural seedlings of this species. *Cullenia* is only less prolific but appears to have greater vitality. *Mesua* finds it hard to make much headway against such odds. Its natural regeneration is less prolific and it demands better light conditions for development, with the result that nature's efforts to reduce the incidence of this species to a minimum is markedly exhibited by the enumeration figures given below :—

Diameter-class.	12″-16″	16″-20″	20″-24″	24″-28″	28″-32″	32″-36″	36″-40″	Over 40″	Total.
Incidence per acre.									
Cullenia excelsa...	1·7	1·6	1·5	1·2	0·9	0·4	0·3	1·2	8·8
Palaquium ellipticum.	1·6	1·3	1·1	0·6	0·4	0·2	0·1	0·2	5·5
Mesua ferrea ..	0·8	0·8	0·7	0·6	0·3	0·2	0·1	0·3	3·8

The reduction in the incidence of *Mesua ferrea* with decreasing diameter when compared with that of *Palaquium* or *Cullenia*, indicates that this community is still progressing towards a climax in which the incidence of *Mesua* is sought to be reduced still further.

An enumeration of a hundred gaps in the Silent Valley for natural seedlings showed confirmatory results. The number of gaps with no established *Mesua* seedling was 26 while those with no established seedling of *Palaquium* was only 13.

In the *Mesua-Calophyllum* association the competition from more shade-bearing and prolific seeders is much less, so that the incidence of *Mesua* is considerably higher in all stages of development. But the conditions of growth are less advantageous, so that the quality is poorer as indicated both by the height and the girth of the best trees. It might be argued that in a locality where the conditions for the growth of *Mesua* are good but those for *Palaquium* or *Cullenia* are not the optimum, both the quality and the incidence of this species should exhibit a marked improvement, and such indeed is the case, as may be seen in the table of incidence for this species for *Mesua-Calophyllum* association, given above. The associates of *Mesua* in this locality are *Palaquium*, *Cullenia* (in smaller numbers) and *Acrocarpus*.

Artificial regeneration.—In Tinnevelley dibblings and notchings of germinating seedlings are reported to have succeeded if the dibbled patches were protected from rats and other vermin by a fencing of reeds or sticks built like a palisade. Young plants are destroyed for the sake of the cotyledons, hence the fencing. The dibblings were carried out in May-June from seeds collected in April.

Nursery transplants, $1\frac{1}{2}$ and 4-5 months old, planted out in July and September-November, have given 78 and 50 per cent. success respectively in the same place. The necessity for fencing the nursery is emphasised. One year old nursery transplants put out at the outbreak of the south-west monsoon have given excellent results in the Chenat Nair Reserve when planted under the high shade of an unbroken top-canopy, with the undergrowth cleared,

For the stocking of gaps created by selection fellings, dibblings in fenced patches and planting out of one-year-old nursery seedlings are therefore indicated. In large gaps the edges near the unfelled forest where high shade is available should be selected. In smaller gaps, where the overhead light is not strong or where there is some middle story to afford the necessary shelter against the sun, any site should do. The undergrowth should not be allowed to swamp the seedlings as this would retard growth considerably and might eventually kill the plants.

In gaps caused by the extraction of *Mesua* it is a good plan to plant or dibble in amongst the branches of the fallen crown, which persists for many years, gives modified shade to the seedlings and affords a natural protection from browsing and other mechanical damage.

The incidence of hollowness at different diameters, as judged during enumeration, is given below :—

Diameter-class.	12″-16″	16″-20″	20″-24″	24″-28″	28″-32″	32″-36″	36″-40″	Over 40″
Percentage hollowness	4·7	8·4	10·5	17·7	21·9	28·7	34·8	48·3

Hollowness increases gradually until it is nearly 50 per cent. for the trees above 40″ in diameter. Constant suppression may be a contributory cause as there appears to be less hollowness in the *Mesua-Calophyllum* association.

The gross volume and net outturn for different girth classes have been computed from results of past fellings :—

Girth class.	3′-4′	4′-5′	5′-6′	6′-7′	7′-8′	8′-9′	9′-10′	10′-11′	11′-12′	12′-13′
Gross c.ft. ..	22	36	48	60	76	93	113	132	152	167
Net c. ft. ..	10	16	23	30	37	45	54	63	72	79

Rate of growth.—Troup gives the following figures for the Nambor forests, Sibsagar :—

1 ft. 6 in.	..	..20 years.
3 ft.	..	..40 years.
4 ft. 6 in.	..	..60 years.
6 ft.	..	..90 years.

Palaquium ellipticum.

This tree is a strong shade-bearer and it appears in more or less pure patches where the soil is deep, moist and well-drained between 2,500′ and 3,500′ above sea-level. It cannot tolerate ill-drained soil or stiff clay and is therefore rarely found in reed associations. It is more exacting than *Mesua* or *Calophyllum* in its demands on the soil, on rainfall and on elevation, so that it is confined to the best soil, under the heaviest rainfall and rarely escapes from its zone.

Its incidence in the *Palaquium-Cullenia* and *Palaquium-Mesua* associations is given below :—

Diameter-class.	12″-16″	16″-20″	20″-24″	24″-28″	28″-32″	32″-36″	36″-40″	Over 40″	Total.
Cullenia-Palaquium ..	1·6	1·3	1·1	0·6	0·4	0·2	0·1	0·2	5·5 trees per acre.
Palaquium-Mesua	3·0	2·0	1·2	0·6	0·3	0·9	0·5	0·4	8·9 trees per acre.

Leaf-shedding, flowering, etc.—Old leaves fall in October-November and young ones take their place simultaneously. The tree flowers in January-March, and the fruit ripens 15 months later with the onset of the south-west monsoon in June : it sometimes germinates on the tree but usually does so immediately after reaching the ground. The seeds contain a large percentage of oil, very similar to *mohwa*-oil (*Bassia latifolia*) and has been reported to be suitable for soap-making.

Silviculture.—The tree is one of the strongest shade-bearers in these rain-forests. In the associations it dominates it shows a strong

tendency to oust weaker shade-bearers like *Mesua* and *Calophyllum*. The table under *Mesua ferrea* giving the comparative incidence of these two species will amply substantiate this.

It seeds almost every year from April to June and good seed years are frequent. The seeds in these forests are not sought after by vermin so eagerly as in Tinnevelley, so that natural regeneration under suitable conditions is prolific. Under the heavy shade of the mother trees, where light conditions are scarcely favourable for thick undergrowth, the floor is usually carpeted with seedlings 1′ to 3′ high. Established regeneration or advance growth is rarely met with under such conditions, but when a break in the top or middle canopy lets in sufficient light for the stimulation of growth, poles and advance growth are met with in numbers.

This happy state of affairs is a common feature of the forest near Palamalai in the Chenat Nair Reserve as a result of past unregulated fellings, as also in the private forests less ruthlessly exploited. In some of the old gaps, a descending order of height classes with stalwart poles in the centre, dwindling gradually into one-year-olds within the forest, afford examples typical of text-book illustrations. Within its associations therefore there is scarcely a place where the regeneration of *Palaquium* is entirely lacking. Enumeration of seedlings over a hundred gaps in the Silent Valley revealed only 5 gaps with no *Palaquium* regeneration.

On coupe lines demarcated by the removal of the undergrowth and most of the middle story, two years' observation of natural seedlings has not revealed any adverse effects. Further observations and experiments are however necessary for the determination of the right degree of light to be admitted in order to establish and stimulate the profuse natural regeneration that often exists on the ground. The problem appears to offer a comparatively easy solution.

Artificial regeneration.—The prolific natural regeneration that often attends *Palaquium* in these forests precludes the necessity for raising it artificially. In Tinnevelley dibblings in patches protected by fences have yielded satisfactory results. Transplanting

nursery plants two weeks old, with their cotyledons clipped off to reduce the attention of vermin, has also given encouraging results.

The gross and net out-turn and the incidence of hollowness at different diameters are given below :—

Girth-class.	3′-4′	4′-5′	5′-6′	6′-7′	7′-8′	8′-9′	9′-10′	10′-11′	
Gross ..	20	35	54	75	97	118	136	147	c.ft.
Net ..	10	17	30	39	48	56	62	66	c.ft.

Diameter-classes.	12″-16″	16″-20″	20″-24″	24″-28″	28″-32″	32″-36″	36″-40″	Over 40″
Percentage hollowness.	2·2	3·2	5·6	7·2	8·9	13·8	20·3	25·9

The demand for this species is at present mainly in the dry districts of Madras and Bombay Presidencies, in the shape of *kolmarams* and *chattams*. The *kolmaram* measures 15′×5″×4″ and the *chattam* 10′×5″×3″ : they are primarily intended for the shafts and frames of bullock carts, but the sizes are suitable for conversion into rafters and it is as such that they are more largely used.

The timber is of medium weight, straight-grained and reasonably immune from white-ants. Properly seasoned, its splitting propensities are no worse than of other well-known timbers, especially when used in districts where the annual range of variation of humidity is not wide. It shows a marked tendency to fungus rot when used as railway sleepers, but if this could be checked by proper preservatives it should make an excellent sleeper wood. Even when not treated, its considerable demand from dry districts as *kolmarams* and *chattams*, shows that its merits have been recognised for house-building. That it is not in brisk demand on the Malabar Coast is due to the availability of better-known timbers from the nearer deciduous forests at about the same price.

The species is capable of accommodating a heavy stand per acre under proper silvicultural treatment, and it grows to large dimensions, trees 150 ft. in height and 80—100 ft. with clean cylindrical boles 15 ft.

in girth at breast-height are often met with. It has a marked tendency to gregariousness and it appears to be comparatively easy to regenerate and grow as a pure crop. With a heavily concentrated crop on the ground, costly extraction methods might well be justified. The species thus appears to have great future possibilities.

CALOPHYLLUM ELATUM.

Two different species appear to prevail, one with obovate coriaceous leaves with dark, deeply furrowed bark, and the other with larger, elliptic, membranous leaves with a yellowish smoother bark.

Calophyllum elatum is one of the most widely spread species in tropical evergreens and is very accommodating. It is found as low as 1,500′ above sea-level near perennial water courses, and it rises up to 5,000′ or more into the temperate evergreens where it becomes stunted. It grows best on deep well-drained soil at elevations between 2,000′ and 4,000′ but is sometimes the only important species that prevails in marshy reed-associations. It is one of the pioneers to succeed *Symplocos*, *Gordonia* or *Elaeocarpus*, in the natural process of the extension of a *shola* into a neighbouring grass-land. On rocks or in swamps it thrives but it exhibits marked gregariousness only when free from the competition of heavy shade-bearers like *Palaquium ellipticum*, as in reed associations or at elevations above 4,000′ *e.g.*, round Poonmalai Bungalow in the Silent Valley. It is not at its best here, however. It is one of the most important associates in our most eastern *sholas* as in Bolampatti Block II, where its quality is poor, however, for a double reason,—elevation and low rainfall.

Flowering, fruiting, etc.—The flowers appear from February onwards and the fruit ripens in May.

Seed years are not frequent.

Silviculture.—The tree is a shade-bearer of about the same degree as *Mesua ferrea*, but it cannot compete with *Palaquium ellipticum*. Young seedlings, advance-growth and poles are found scattered about but gregariousness is exhibited only when comparatively

free from the competition of heavier shade-bearers (*Palaquium* and *Cullenia*). Seedlings want shade when young and persist for a long time under a mass of *Strobilanthes*, a common under-story in the *Calophyllum-Mesua* association. One-year-old nursery transplants put out under high shade with the undergrowth removed have shown marked success in the Chenat Nair Reserve, though dibblings in the forest failed.

The wood is cross-grained, but has a pretty appearance. The timber is liable to much warping if used on the West Coast, but kiln-seasoned wood has been used in the drier districts for motor-bus bodies with satisfactory results. There is some demand from the dry districts for *kolmarams* and *chattams* but *Palaquium* is preferred.

Acrocarpus fraxinifolius.

A deciduous species inhabiting semi-evergreens, it is sometimes met with in the true *sholas*. It is conspicuous in the semi-evergreens of Chenat Nair Reserve, in the transition stage between monsoon forest and rain-forests (1,500′ to 2,000′) and in the somewhat drier *sholas* of Attapadi Blocks I to V. It is found at its best in the *Mesua-Palaquium* association of the Anangan-thodu Valley in Attapadi Block I, where it grows to enormous dimensions. In the *Mesua-Calophyllum* association of the easternmost slopes of Attapadi Block V at elevation of about 4,000′ it occurs in a stunted form. A tall graceful tree of large dimensions, it is conspicuous by its plank-buttresses and by its bark that peels off from the bottom in long curved flakes.

Leaf-shedding, flowering, etc.—The tree is leafless early in November and young leaves and flowers appear in November-December. The flowers are sought after by birds, which destroy some of the inflorescence. The pods which are light and easily broken off are blown long distances by the wind. They ripen from March to May.

Silviculture.—The species is a strong light-demander and often appears in small groups. The young seedlings cannot tolerate the least amount of shade after the first few months, but soil-dessication should be guarded against in the early stages under semi-evergreen

conditions as the species is not deep-rooted. Early growth is phenomenal, one-year-old seedlings four feet high being common.

Natural regeneration in gaps in semi-evergreen forests is prolific in the year that the gap is created and when the ground is reasonably clear of weeds. Seedlings grow in crowds and grow fast, but are eventually overtopped by faster growing weeds like *Trema orientalis*, *Leea sambucina* or *Macaranga roxburghii*, and overtopped seedlings mostly perish by the end of the second season. This has been clearly observed in the *rigs* (cleared strips along which the sky-line for high skidding was run when the Chenat Nair forests were logged under American methods). Once ahead of the weeds for two or three successive years, the tree grows so fast that very few weeds can catch it up.

In the Chenat Nair Reserve an area of logged evergreen forest was clearfelled and burnt and attempts were made to stock it with species like *Palaquium ellipticum*, *Vateria indica* and *Cullenia excelsa* without success. A later attempt to plant *Hopea parviflora* and *Artocarpus hirsuta* met with partial success, but the most prominent crop on the area now is *Acrocarpus fraxinifolius* from the adjoining seed trees. The attention bestowed on *Hopea* seedlings kept the weeds out of the area, with great advantage to the naturally sown *Acrocarpus*.

Artificial regeneration.—The germination percent of untreated seeds seldom exceeds 20 per cent. but those treated with strong sulphuric acid for 20 minutes have given as high as 48 per cent. in Tinnevelly. The cotyledons and the first pair of leaves of seedlings raised from acid-treated seeds are often bleached white, but this passes. The germination period is 2-4 weeks but seeds have been known to lie dormant for a whole year under rain-forest conditions, and germinate at the end of it. Treated seeds germinate quickly.

Dibbling in May of patches in the gaps made by selection fellings in the Silent Valley gave very promising results during the first year, but it was found that seedlings receiving direct overhead light in the middle of the gaps showed much faster growth than those

at the edges. Seedlings in the middle of small gaps where the overhead light was feeble showed poor growth. At the end of the second year the results were discouraging. A lepidopterous caterpillar, *Terias sylhetana*, completely defoliated almost every plant in November, but this was probably not very serious as the ravages were on the old leaves which would normally be shed in that month. A second generation has however been observed in June-July, and this must have had more serious consequences. At the end of the second year, the results have, on the whole, been disappointing. Except in the centre of the largest gaps, *Acrocarpus* does not hold out much hope in the regeneration of gaps in the *sholas*. It is not suited for growing in pure plantations as it has a host of enemies. Game destroyed a whole plantation of this species some 20 acres in extent at Mt. Stuart, when it was 1 to 3 years old by completely stripping the bark from young trees.

The timber is valued mainly for cart-shafts for which very good prices are obtained, *e.g.*, up to about Rs. 3 per c. ft. for a *kolmaram*. Annual rings can only be counted with some difficulty. A tree 6′-6″ in girth at breast-height showed 65 rings in the Silent Valley at 3,200′.

DYSOXYLUM MALABARICUM.

A tall graceful tree with a clean, straight cylindrical bole growing scattered in the rain-forests between 2,500′ and 3,500′. It is found on deep, well-drained soil. The bark has characteristic vertical and horizontal lenticels of a light, corky colour. The timber used to be in large demand on the West Coast of Madras for the manufacture of oil casks used in exporting cocoanut oil to the European markets, but with the export of copra instead of oil the demand for this species has fallen considerably. The wood is pale yellow, has a fine scent and is very durable.

The tree flowers in February-March and young fruits are in evidence in June but do not ripen till August. Red squirrels and monkeys eat a large quantity of the fruits and *Trypetid* larvæ account for a good number of what is left. It was only by isolating a seed tree

and protecting its trunk with thorns that some seeds could be collected. The seeds germinate by the middle of September but the cotyledons and young shoots are eaten by monkeys and squirrels, so that it is difficult to raise them in the open without protection. Seedlings grown under wire netting were exposed after they lost their cotyledons and are now free from danger.

The percentage of germination is high, over 75 per cent. if only sound seeds are taken into consideration. A fungus attacks the seeds if kept unsown for any length of time. The multitude of its enemies obviously accounts for the small number of natural seedlings observed in the forests. Possible solutions are to fence dibbled patches, or to transplant from a nursery after the seedlings have lost their cotyledons at about the age of six months. The species is suitable for introduction into small gaps under shade or at the edges of larger gaps.

These notes are the result of a study of the rain-forests of the Palghat Division, for which a working plan is in the course of preparation. It is proposed to adopt a modified selection system under which merchantable trees above a minimum girth and limited to a maximum of three trees per acre may be extracted. Natural regeneration of useful species in the gaps created by fellings will be tended and where these are deficient, valuable species such as *Mesua ferrea*, *Gluta travancorica*, *Dysoxylum malabaricum*, *Acrocarpus fraxinifolius* and *Artocarpus hirsuta* will be artificially introduced and tended. Promising advance growth of valuable species will also be tended.

It is thus proposed to bring these forests under systematic economic exploitation for the first time, without endangering their essentially evergreen character and to improve substantially their future value by increasing the number and variety of valuable species in them.

FOREST COLLEGE SPORTS AT DEHRA DUN.

BY D. DAVIS, I. F. S.

The annual College Sports were held at Chandbagh on the afternoon of April 1st, 1932. The Inspector-General of Forests, Mr. Blascheck, and the Gazetted Officers of the College were at home to the students and their friends as well as to a few other guests, and the officers of the Research Institute were also present. The weather was fine and comparatively cool after the rain which fell two days previously, and about 150 spectators witnessed a very successful meeting.

The first event, the 100 yards, was run punctually at 3-30 p.m., and was won by Senior Ranger Student N. C. Mukherjee, who won the Championship Cup last year. Great interest was evinced in the competition for the Cup this year, as Mukherjee had a serious rival in Junior Ranger Student Fazal Gul Khan, who had already before Sports Day won 5 events, *viz.*, the 8 mile Marathon, ½ mile, mile, throwing the Cricket Ball, and Putting the Weight ; while Mukherjee had won the Long Jump, and been 3rd in Putting the Weight, having thus got only 6 points compared with Fazal Gul Khan's 27. As Fazal Gul Khan was 2nd in the 100 yards, he had now 30 points to Mukherjee's 11, and had only to win one more event to make his position safe. Thus after Mukherjee had won the 120 yards Hurdles, great excitement prevailed when in the ¼ mile, Mukherjee, after leading most of the way, was beaten by Fazal Gul Khan.

A new event was a one-mile relay race between teams of five representing the Forest College and the Forest Research Institute, the distances being 110 yards, 110 yards, 220 yards, ¼ mile, and ½ mile. The Research Institute sprinters quickly gave their side a lead, which was maintained until their last man was within 100 yards of the tape, when Fazal Gul Khan, who had started the ½ mile a long way behind, and had been gradually overtaking his opponent, took the lead amidst great excitement, and winning easily after an excellent race, gave the victory to the College.

The children's race, as last year, entailed much preliminary manœuvring on the part of parents and nurses, but once started proved a good race, and was won by Sheila Barker closely followed by Raj Hans, the son of Mr. Mul Chand Minhotra.

The two team events, the Tug-of-War and Sack Scrimmage, were closely contested, and as usual the latter caused great amusement, as also did the Obstacle Race and the Spar Fighting, in both of which the water tank played a conspicuous part.

At the close of the Sports the prizes were presented by Mrs. Blascheck, the winners being as follows :—

8-mile Marathon ..	Fazal Gul Khan ..	53 min. 23 $\frac{7}{10}$ sec.
100 yards ..	N. C. Mukherjee ..	11$\frac{1}{5}$ sec.
$\frac{1}{4}$ mile ..	Fazal Gul Khan ..	59$\frac{2}{5}$ sec.
$\frac{1}{2}$ mile ..	Do. ..	2 min. 25$\frac{1}{2}$ sec.
Mile ..	Do. ..	5 min. 29$\frac{3}{10}$ sec.
120 yards High Hurdles ..	N. C. Mukherjee ..	21 sec.
High Jump ..	N. N. Kaul ..	4 ft. 10$\frac{1}{2}$ in.
Long Jump ..	N. C. Mukherjee ..	15 ft. 7$\frac{1}{2}$ in.
Putting the Weight ..	Fazal Gul Khan ..	27 ft. 8 in.
Throwing the Cricket Ball	Do. ..	82 yds. 1 ft. 7 in.
Obstacle Race ..	S. K. Dattaray ..	..
Spar Fighting ..	Dharam Chand ..	..
Championship Cup ..	Fazal Gul Khan ..	35 points.
Consolation Prize ..	Majir-ud-Din Ahmad ..	..
Junior Staff Race—220 yards	Puran Singh ..	29 sec.
Relay Race—1 mile ..	Forest College ..	4 min. 19$\frac{3}{5}$ sec.
Sack Scrimmage ..	Senior Students ..	..
Tug-of-War ..	Senior Students ..	2 pulls to nil.

The times and distances were mostly not up to the usual standard, chiefly as a result of insufficient time for training, and of having to run the Marathon within 8 days of Sports Day.

COLLEGE RECORDS.

100 yards ..	.. 10 $\frac{3}{5}$ sec. (1914).
$\frac{1}{4}$ mile ..	.. 55 $\frac{4}{5}$ sec. (1911).
$\frac{1}{2}$ mile ..	.. 2 min. 14 sec. (1911).
Mile ..	.. 5 min. 11 $\frac{1}{5}$ sec. (1913).
120 yards Hurdles ..	.. 17 sec. (1909).
High Jump ..	.. 5 ft. 8 in. (1909).
Long Jump ..	.. 20 ft. 2 in. (1914).
Throwing the Cricket Ball	.. 116 yards 1 ft. (1893).
Putting the Weight (16 lbs.)	.. 34 ft. $1\frac{1}{2}$ in. (1891).
8 miles Marathon	.. 47 min. (1927).

NOTE.—The available records from which the above have been taken are incomplete, and if any reader knows of better performances and can send authentic record of them, the writer will be grateful.

PROCEEDINGS OF THE SEVENTH SPIKE CONFERENCE HELD AT THE INDIAN INSTITUTE OF SCIENCE, BANGALORE, ON MONDAY, THE 25th APRIL 1932, at 10 a.m.

PRESENT :

Madras Province	.. Mr. R. D. Richmond, I.F.S.
	Mr. T. A. Whitehead, I.F.S.
	Mr. A. M. C. Littlewood, I.F.S.
	Mr. A. A. F. Minchin, I.F.S.
	Mr. W. G. Dyson, I.F.S.
	Mr. K. R. Venkataramana Ayyar, I.F.S.
	Mr. S. K. Basu, I.F.S.
	Mr. S. Rangaswami.
Mysore	.. Mr. B. V. Ramiengar, B.A.
Coorg	.. Mr. H. A. H. G. Hicks, I.F.S.
	Mr. U. K. Thimmaiya.

Forest Research Institute, Dehra Dun.	Mr. J. C. M. Gardner, A.R.C.S., D.I.C., F.E.S., I.F.S.
	Mr. N. C. Chatterjee, B. Sc., F.E.S.
	Mr. C. Dover.
Indian Institute of Science, Bangalore.	Dr. H. E. Watson, D. Sc., F.I.C., M.I. Chem. E. (Chairman).
	Dr. V. Subrahmanyan, D.Sc., F.I.C.
	Mr. M. Sreenivasaya, B.A., A.I.I.Sc.
	Mr. A. V. Varadaraja Iyengar, M.Sc., A.I.C., A.I.I.Sc.
	Mr. Y. V. Sreenivasa Rao, B. Sc.

The Chairman in opening the Conference suggested that it would be desirable, before proceeding with the written agenda, to define the position of the various bodies now concerned with research on spike, and pointed out that last year it was decided to institute two committees, (1) a Working Committee and (2) a Control Board. The exact function of neither body had been laid down at the time and some confusion had since arisen. After some discussion, it was agreed that as far as the investigation conducted by the Indian Institute of Science in collaboration with the Government of Madras and Coorg were concerned, the Director of the Indian Institute of Science should be regarded as being in charge of the whole investigation. The annual conference which is open to anyone interested in spike is an Advisory Body. The Control Board, consisting of the Director of the Indian Institute of Science, the Chief Conservator of Forests, Madras, and the Forest Entomologist, Dehra Dun, should examine all papers connected with the investigation before publication including the quarterly reports of the Working Committee. The Working Committee is to be responsible for carrying out the programme approved by the annual conference, making such minor alterations as are necessary from time to time. It should meet at least once a quarter to review progress and make suggestions regarding details of future work. Before making major alterations in the programme, the Director of the Indian Institute of Science, should be consulted.

Mr. Ramiengar, Chief Conservator of Forests in Mysore, pointed out that in 1930 it had been agreed to constitute a control board with representatives of the Mysore Government as members but that owing to some misunderstanding it had not so far held meetings. The meeting decided, unanimously, that co-operation between the Mysore Government and the other workers upon spike was most desirable and requested Mr. Ramiengar to do his utmost to obtain the necessary permission to unite the two investigations. It was emphasised at the same time that what was even more important than a joint board of control was discussion of research problems between actual workers and it was suggested that, if possible, four of the Mysore research workers should join the Working Committee.

In the event of the Government of Mysore agreeing to accept the above proposals, the Board of Control composed as above would be strengthened by the addition of the Chief Conservator of Forests in Mysore, the Director of Agriculture in Mysore and the Chief Forest Officer, Coorg. This Board would not only review publications but would assume charge of the whole investigation, examining programmes from the Working Committee and allocating work. It should meet at least twice yearly.

The first item on the agenda was the review of progress made during the past five years. A quinquennial survey prepared by Mr. Sreenivasaya, previously circulated, was taken as read. The Chairman then summarised the definite results obtained since the beginning of the investigation, as follows :—

a. Transmission.—It has been found possible to transmit spike by grafting. Transmission occurs most readily when leaf tissues are used but attempts to convey the disease by grafting upon the roots have so far not succeeded. These results indicate that the tree is probably infected by agencies above the ground and not through its roots.

b. Recognition.—In addition to the method of recognizing the disease by its usual symptoms, a method of leaf measurement has been developed which is more definite in nature and leads to earlier recognition.

A latent stage of the disease has been found to exist in which the plant is infectious although showing no definite symptoms. These can be caused to develop by pruning the tree.

The composition of the sap from spiked trees has been found to be abnormal in several respects.

c. Resistance.— It has been found that certain varieties or strains of sandal are, in themselves, more resistant to the disease but no definite method of identifying them has so far been evolved. They appear to be characterised by profuse root development and ready formation of haustoria. Differences have been observed in the seeds but these have not yet been correlated with the resistance of the plants raised from them.

The resistance of trees of the same species depends to a large extent upon the nature of host. Certain hosts can be characterised definitely as favourable and others as unfavourable. A host of some kind is essential for normal growth.

Conditions likely to promote the general health of the tree such as good soil, deep roots, sunshine, and the presence of essential mineral constituents in the soil increase the resistance.

Lantana has been suggested as a cause of spike. This does not appear to be the case, but it has been shown that *Lantana* is an unfavourable host and its presence gives rise to conditions which are inimical to healthy growth.

d. Prevention.—The development of spike can be sometimes prevented by lopping or ringing the affected part of a tree but the method is apt to be uncertain owing to the existence of the latent stage of the disease already mentioned.

For killing diseased trees and thereby removing the source of infection, a patent preparation, *Atlas*, which contains sodium arsenite is the best among the tree-killers so far examined.

e. Seasonal Incidence.—The incidence of spike shows a seasonal variation but since the disease takes some time to develop, the season of maximum incidence does not coincide with the period of maximum infection.

f. Causes.—The cause and manner of transmission of the disease are still unknown. A single case of a healthy plant exposed on a platform in the forest becoming infected has been recorded and it is difficult to imagine how this can have occurred except through insect agency. At the same time, no experimental transmission by means of insects has so far been accomplished.

g. Associated Diseases.—Investigations have been made upon plant diseases which are common in spike-infected areas and a type of chlorosis has been induced in healthy sandal trees by means of certain *Curculionids* fed on spiked sandal but further work is needed to establish the relation between this disease and spike.

3. Dr. Subrahmanyan reported that the Working Committee had met at very frequent intervals and had drawn up the quarterly reports which had been circulated to members.

4. The programme of work for the year 1932-33 which was drawn up by the Working Committee was next considered, and it was agreed that the following work should be undertaken :—

PART I.—EXPERIMENTS UNDER SYLVICULTURAL CONDITIONS.

A. Grafting sandal plants growing in association with definite single species of host plants to determine the influence of the latter on resistance to artificial infection.

B. Grafting sandal plants growing under sylvicultural conditions in forests of the semi-evergreen type in which the resistance is known to be high.

Similar experiments on larger trees were to be made at Kenilworth Castle.

C. (1) *Manurial plots : Aiyur.* (*a*) A critical study of individuals and groups of sandal plants in relation to associated hosts to be continued.

(*b*). Observations on seasonal variation in disease resistance.

C. (2) *Jawalgiri* : (*a*) Regeneration with resistant varieties of sandal. Experiments to be conducted with sandal which has so far

resisted artificial transmission under laboratory conditions by introduction into—

1. A highly infected area,
2. The disused manurial plot at Jawalgiri.

Some controls to be kept at the Institute and some exposed in a non-infected area.

(*b*) Observation area : Study the effect of the complete removal of all spiked plants.

(*c*) Quadrat for study of flora : Ecological changes occurring in the area to be observed from time to time for a period of 5 years.

D. Observation Areas.—(*a*) Monthly observations of incidence in Cairn No. 53 area.

(*b*) Study the effect of sowing host plants at Nyamasandiram.

(*c*) Keep the Jawalgiri 6-acre regeneration area under observation, control the introduction of host plants and periodically prune a few sandal trees.

(*d*) Stock the Jawalgiri 4-acre regeneration area with favourable and unfavourable hosts.

(*e*) Complete the floristic survey of the Mahadeswangudi area, collect and examine seeds from this area and try the effect of lopping young plants grown under bushes.

E. Eradication.—Continue experiments with tree-killers.

PART II.—EXPERIMENTS UNDER CONTROLLED CONDITIONS.

The following are to be continued :—

(*a*) Studies in disease transmission, using host plants other than those already experimented with.

(*b*) The effect of special soil constituents.

(*c*) The intercommunicability of associated diseases.

(*d*) The infection of pot-cultured plants placed in spiked areas.

PART III.—LABORATORY INVESTIGATIONS.

These are to deal with the following subjects :—

(*a*) Factors of disease resistance in sandal plants.

(*b*) Biochemical examination of plants with associated diseases.

(*c*) Metabolic studies in healthy and diseased sandal plants.

(*d*) The isolation of the infective principle and studies thereon.

(*e*) Physiological studies with particular reference to seeds and root systems.

5. The next item was the entomological programme which was put forward by Mr. Gardner and discussed. Mr. Gardner pointed out that the main object of the entomological investigation was to ascertain if any insect can transmit spike. Past work had indicated possible vectors and which of these were the more probable.

The experiments proposed for the current year were as follows :—

1. Group transmission experiments on *Zizyphus* spike in addition to sandal spike, *Acacia farnesiana* being the host in the latter case.
2. Life history studies of probable vectors.
3. Examination of scars to ascertain if a classification is possible.
4. The possibility of transmitting the supposed virus disease of *Aegeratum* by insects.
5. If time permits, the survey of small spiked and unspiked areas.
6. A limited number of mass infections.

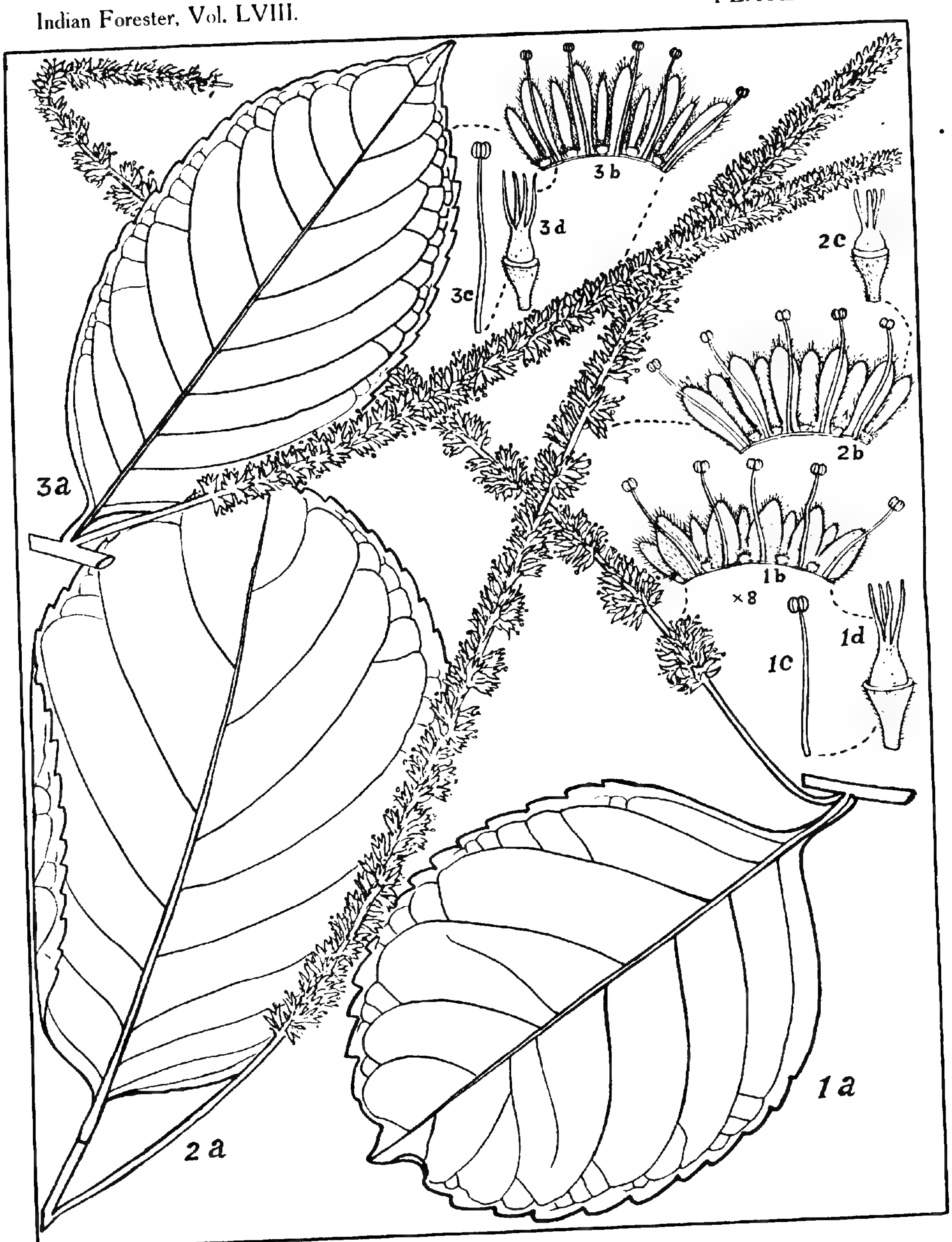
6. The question of continuing the Quarterly Reports in their present form having been raised, it was resolved that the Working Committee should present a quarterly progress report to the Director of the Institute of Science (or to the Control Board in the event of the Government of Mysore collaborating) for private circulation among members, and that half-yearly printed reports be published after review by the Control Board. In all cases these reports should contain a summary of the more important results achieved.

HERBARIUM NOTES ON HOMALIUM BHAMOENSE. CUBIT AND SMITH.

By K. Biswas, M.A.

Curator of the Herbarium, Royal Botanic Garden, Calcutta.

Mr. P. C. Kanjilal, I. F. S., Deputy Conservator of Forests, while going through the sheets of *Homalium bhamoense* in connection with his preparing the " Flora of Assam " came across a large number of intermediate forms of *Homalium bhamoense*, Cubit and Smith, showing different stages of its growth. All of these (including the typical specimen of *H. bhamoense*) are closely allied to *H. zeylanicum*, Bth. and both he as well as myself are led to think that Bentham's *H. zeylanicum* perhaps includes all of these forms of *H. bhamoense*. The different forms of *H. bhamoense* may very well be taken as an eastern race of Bentham's *H. zeylanicum*. There are, however, some important characters in *H. bhamoense* differing from *H. zeylanicum* and Cubit and Smith are to a certain extent entitled to retaining *H. bhamoense* a separate species. I would perhaps prefer to make these forms of *H. bhamoense* a new variety of *H. zeylanicum* instead of raising it to the rank of a species. Kanjilal too, as his field notes and observations in Herbarium indicate, comes to the same conclusion. On considering, however, the extreme forms of *H. bhamoense*, Kanjilal, as his large number of specimens show, is fully authorised to name his Assam form and the Burma specimens of this herbarium having larger flowers, narrower leaves, more elongated sepals and petals and other minor characters of the flowers and inflorescence, *i.e.*, to keep the Assam and Burma forms definitely separate from the typical *H. bhamoense*. He has, therefore, formed a new *variety* viz., *H. bhamoense* var. *Debbarmanii*, Kanjilal (junior), accepting Cubit and Smith's *H. bhamoense* a recognised species as accepted in Index Kewensis. The late Mr. Debbarman was rather premature in considering these Assam and Burma forms as new species. Definite specific characters separating the different forms of *H. bhamoense* from the numerous forms of this new variety *H. bhamoense* var. *Debbarmanii*, Kanjilal, are entirely



Homalium bhamoense: For explanation of figures see text.

failing. Of this new variety of Kanjilal, as will be published in his forthcoming " Assam Flora ", he has again found two forms: one hairy more allied to the type " forma typica " and the other glabrous. He has, therefore, made a new form of these glabrous individuals, calling them " forma glabra " Kanjilal. Kanjilal's note on the sheet is available for consultation in this Herbarium.

Explanation of Figures.

Fig. 1. (*a*) A single leaf with inflorescence of *Homalium zeylanicum*. Natural size.

(*b*) A flower of *H. zeylanicum*, spread out, x 8.

(*c. & d.*) Stamen and pistil with style and stigma of the same—x 8.

Fig. 2. (*a*) A single leaf with the inflorescence of *Homalium bhamoense*. Natural size.

(*b*) A flower of *H. bhamoense* spread out—x 8.

(*c*) Pistil with style and stigma of the same—x 8.

Fig. 3. (*a*) A single leaf with inflorescence of *Homalium bhamoense*, var. *Debbarmanii*. Natural size.

(*b*) A flower of *H. bhamoense* var. *Debbarmanii* spread out—x 8.

(*c. & d.*) Stamen and pistil with style and stigma of the same—x 8.

NURSERY EXPERIMENTS WITH SPRUCE SEED.

By K. L. Aggarwal, I.F.S.

1. The problem of regenerating the fir forests has not so far been studied to any great extent in the Punjab.

Although a certain amount of natural seedlings are met within the mixed deodar and fir forests and also where the latter occurs in mixture with the broad-leaved species, there is almost a complete absence of any natural regeneration in pure spruce and silver fir areas. The existing stock in these forests in the Seraj Forest Division in the

Kangra District consists almost entirely of overmature trees and the necessity for a solution of the problem of regenerating is evident when it is borne in mind that not only are these trees deteriorating financially but that the deterioration has already proceeded so far that most trees turn out rotten and do not yield any sleepers. It is evident that the old stock has to be regenerated and that we shall very largely have to fall back on artificial methods.

At the time of the Punjab Forest Conference, 1930, the 'Spruce and Silver Fir Committee', amongst other matters, emphasized the necessity for carrying out nursery experiments with a view to test the germination percent of seed collected from trees of various diameter classes and the best season for sowing.

2. Accordingly in 1931 nursery experiments were started in four different forests, one in each range of the Seraj Forest Division, by the writer with a view to determine the fertility of spruce seed obtained from trees of different diameter classes and to find out the best season for sowing. Only spruce (*Picea morinda*) seed was available and the following note therefore refers to this species alone.

Two sets of experiments were carried out as under :—

The first set was to ascertain the fertility of spruce seed obtained from trees of the following diameter classes :—

12″—17″, 18″—23″, 24″—26″, 27″—29″, 30″—32″, 33″—35″ and 36″ and over ; it consisted in sowing during January an equal quantity (by number) of the different sets of seed in lines 6″ apart in raised nursery beds 4′×3′ under exactly similar conditions. The second set consisted of sowing a definite quantity of mixed seed at three different seasons, *viz.*, winter, spring and rains, in nursery beds as above. Sowings were made in the beginning of January (6th) before snowfall, in the end of March, and, lastly, in the end of June, and a detailed record of the germination was kept. Two of the four nurseries did not come to much—chiefly on account of ravages by birds and insects—but the results obtained from the other two nurseries have been both interesting and encouraging and are recorded here for further verification and confirmation.

3. The sites in both cases were suitable for spruce with a north to north-east aspect at an elevation of 7,500′ in one case ($^1/_2$ Sharu Nal, Inner Seraj Range) and 8,600′ in the other (R/3 Jujuth, Outer Seraj Range).

The present stock in both these areas consists of a mixture of this species with deodar.

4. The following tabular statement gives the results of the observations made :—

1st Experiment.—Seed sown = 500 in each case by diameter classes.

Diameter class.	INNER SERAJ RANGE.			OUTER SERAJ RANGE.		
	No. of seed that germinated and germination percentage.	*Survivals in* 10/1931.	*Survivals in* 5/1932.	No. of seed that germinated and germination percentage.	*Survivals in* 10/31.	*Survivals in* 5/32.
12″—17″ ..	100 20%	25 5%	Nil	103 21%	20 4%	12 2%
18″—23″ ..	101 20%	40 8%	26 5%	105 21%	36 7%	22 4%
24″—26″ ..	110 22%	55 11%	25 5%	118 24%	71 14%	40 8%
27″—29″ ..	72 14%	30 6%	5 1%	102 20%	40 8%	38 8%
30″—32″ ..	46 9%	10 2%	6 1%	61 12%	12 2%	Nil
33″—35″ ..	56 11%	20 4%	15 3%	101 20%	31 6%	Nil
36″ & over ..	38 7%	15 3%	12 2%	63 13%	32 6%	32 6%

2nd Experiment.—Seed sown at each time = 2,000.

Month of sowing.	*Germination commenced on*		*Germination completed on*		Survivals in			
					August 1931.		*May* 1932.	
	I. S.	O. S.	I. S.	O.S.	I. Seraj.	O. Seraj.	I. Seraj.	O. Seraj.
1	2	3	4	5	6	7	8	9
Early January 1931. ..	2nd May 1931.	20th May 1931.	10th July 1931.	17th July 1931.	223 11%	328 16%	75 4%	142 7%
March 1931 ..	,,	,,	,,	,,	145 7%	156 8%	48 2%	148 7%
End of June 1931 ..	16th July 1931.	15th July 1931.	27th July 1931.	20th July 1931.	284 14%	912 46%	121 6%	859 43%

NOTE.—The figures in columns 6-9 do not include those seedlings that germinated but died out as they are actually of no account. It will be seen from a perusal of columns 2-5 that germination extended over a period of 7-9 weeks in case of January and March sowings and though the actual germination percent was higher, the seedlings continued to die on account of summer drought. There were occasional showers during May and June but the rains did not start until the 5th July and there was again a lull for nearly a month between the 20th July and 18th August during which period the weather was unusually dry for the time of the year. Winter, too, was exceptionally dry and there was little snow.

5. The following tentative conclusions may be arrived at from the above :—

(*i*). Germination in the case of patches sown in January and March took as many as 7-9 weeks to complete, whereas seed sown in the end of June germinated in about a week's time.

(*ii*). In the course of germination of the seed sown in January and March many seedlings continued to die on account of drought, as might have been expected, and in August the survivals were only 16 per cent. and 8 per cent. as compared to 46 per cent. in case of seed sown in June just before the monsoon rains. In the case of June sowings in Inner Seraj Range the difference is not so great and this was due to ravages by insects in those patches. The very fact that autumn and spring sowings take such a long time to germinate completely is sufficient to indicate that they are not

likely to come to anything as the season is usually dry and seedlings cannot be expected to establish themselves. The difference in percentage of survivals in case of Jujuth Forest (Outer Seraj) is so great as to admit of no doubt whatsoever and clearly proves that June sowings just before the break of the monsoon give the best results in case of spruce and should be the rule if success is to be obtained.

(*iii*). Winter sowings before snow gave somewhat better results than spring sowings.

(*iv*). Seed from 24″—26″ class trees gives the best results, with seed from 18″—23″ and 27″—29″ diameter classes coming next.

(*v*). Seed collected from trees of more than 29″ diameter gave a lower percentage.

(*vi*). Seed from trees 12″—17″ diameter gave nearly as good germination results as seed from the 18″—23″ class or trees above 29″ diameter but the mortality has been so much greater that at present only 2·1 per cent. seedlings survive in one forest while in the other all have died out.

(*vii*). There is a decided fall in germination percentage and survivals in the case of seed collected from trees 30″—32″ in diameter but there is again a rise for 33″—35″ diameter class. In Outer Seraj all the seedlings from both the diameter classes have died but in Inner Seraj there are still 2 per cent. and 1 per cent. survivals, respectively.

6. The above experiments cannot be claimed to be conclusive as they extend over a period of one year only but a start has been made and they appear to be of sufficient interest to warrant publication in the *Indian Forester*. There appears to be no doubt that June sowings for spruce are best, but as regards germination percent for seeds of different diameter classes it would be necessary to undertake sowings in June instead of in January as was done in this case. It was intended to continue these experiments but the work was taken up by the Silvicultural Research Division and all the available seed that had been collected last October for the purpose was despatched to that Division.

THE RIVER IRE; AN EXAMPLE OF TORRENT CORRECTION.

Many instances have been given of the beneficial influence of forests on the flooding and regulation of rivers, but we cannot have enough observations on this subject and we believe that the history of the Ire basin in Savoy is worthy of study.

The Ire has its source in the *massif* of the Bauges at the Col de Cherel (1,500 metres a. s.l.) and empties itself into the Lac d'Annecy (450 metres) after a course of 14 kilometres. In the lower reaches it traverses flat cultivated ground with an average slope of 1·7 %, but above the last houses of the village of Chevaline it enters a narrow gorge overshadowed by steep escarpments on both banks and in this catchment area the flanks are covered with a continuous belt of forest for nearly 10 kilometres. Finally, at a short distance from the Col de Cherel the valley spreads out to form an amphitheatre of alpine pastures hemmed in by great cliffs. The Ire thus has an agricultural lower course, a forested middle course and a pastoral upper one; the forested portion is by far the most important both on account of its length and of its influence in regulating the flow.

The soil is a marly clay, and extensive screes and glacial deposits cover the lower slopes. On the whole the soil is fresh and fertile but easily waterlogged, and as the valley runs north and south and has a heavy rainfall, one can understand that erosion in every form is found whenever the protection of the forest is withdrawn. The conditions are fortunately very favourable to forest growth which stretches unbroken over large areas. Fir, beech, spruce and maple form the bulk of the woods in a proportion of roughly 40, 25, 15 and 5 per cent. of each.

With a valley bottom only the width of the river itself and with slopes so steep and unstable, the making of roads through the valley has not been easy. Up to 1857 only mule-tracks existed along each bank and leading to the alpine chalets. This gloomy stretch of forest in a wild and difficult gorge was the home of bears—the last only disappeared in 1900—and has always been looked upon as an inhospitable and mysterious region of which the old folks spoke in awed whispers.

During centuries it remained untouched except along the lowest fringe. The only needs were for firewood and the few handicrafts of a rural district, and these could be satisfied from the more accessible lower parts of the forest. Only a few charcoal-burners would venture farther afield. The higher catchment area of the Ire was influenced only by the natural forces which had been in operation for thousands of years.

The situation changed from the beginning of the 18th Century. At this time the metal industry developed rapidly in Savoy and particularly in the valley of Faverges which adjoins the Ire. Two great furnaces were installed, the one at Seythenex by the Cistercian monks of the Abbey of Tamié, the other at Giez, complete with forges and anvils. The only fuel available was charcoal, and as one furnace alone used over 7,000 cubic metres annually, the nearest hillsides were rapidly exhausted of wood and fellings had to spread farther afield. Charcoal from the Ire forests was carried by mule to Giez, and a forge was even set up later on in the forest and the noise of hammers broke the silence of these woods. The forests of the lower and middle Ire would have been entirely destroyed had it not been for the Revolution which paralysed the local industry and temporarily stopped this disforestation. Under the Restored Monarchy, thanks to the help of customs protection, the industry took on a new lease of life and drew once more upon the Ire forests. All the communal forests were heavily worked and even the private forests towards the head of the valley suffered. In 1857 a road was opened up along the valley bottom; many wooden bridges were necessary and the nature of the soil made construction difficult. It was however completed, and this led to the exploitation of the virgin forest of Doussard, hitherto untouched. This contained many huge old spruce, beech and maple, and the countryfolks still remember the felling because of the enormous yield it gave, and the length of time it took to fell, for the wood-cutters only left it in 1878, and also from the fact that Henri Bordeaux used this particular forest as a setting for one of his romantic novels. Not a tree was spared. One which was felled measured 48 metres in height, 3 metres in diameter at the base, and yielded 37 cubic metres of wood (1,000

cubic feet) ; a section of this trunk was shown in the Exposition Universelle de Paris of 1878.

In 1894 the old private forest of Chartreux d'Aillon was worked, and continued up to 1899. It was done by means of a slide several kilometres in length which in the opinion of the woodsmen was a masterpiece of its kind, but the felling was done in the same old way, and not a tree was left standing. Two small forests belonging to the pastoral syndicate of Planay were spared from clear-felling only because they were protected by an old Act of 1693 under which they had to be retained to supply certain rights. One compartment of about 10 hectares still remains untouched, the only surviving example of the primeval forests of the district.

The 20th Century has been kinder to the valley of the Ire. Thanks to favourable conditions of climate the forest has grown again. Conifers first established themselves, and later the hardwoods came in to form a mixture. Actually there are now no traces of disforestation, and the future promises better things. Since 1910 the State has acquired most of the higher forests while the communal forests in the lower belt have been under the control of the Forest Service since 1860 and have been worked only under very careful Selection fellings. Since the beginning of the 18th Century the condition of the forest has never been so satisfactory as it is now, with a protective canopy of forest stretching unbroken through the valley.

The story of the forests having been told, let us pass to the story of the river Ire itself As far as the records of Savoy go back we can find nothing about the stream before 1720. Now if peaceable nations have no history, the same may be said of streams. Since 1720, however, the Ire has a long record of evil activity, causing frequent floods and havoc. (Ref. Mougin's "Torrents de la Savoie" 1914). Many times it overturned piers and bridges, destroyed the Annecy—Faverges road, smothered cultivation, damaged sawmills, houses, churches. It was a most troublesome neighbour, and the inhabitants of Doussard lived with their eyes fixed upon it. They defended themselves as well as they could by clearing out the channel, making dikes,

and raising the road level, but without much success. The detritus carried down sometimes amounted to a depth of 3 metres of débris upon their fields.

Two periods were specially noted in the history of the river, namely, 1860 to 1880 and 1898 to 1905, reaching their peaks of flood and damage in 1874 and 1899. From 1905 onwards the situation became gradually easier, the flow being steadier, the detritus deposits less, and floods less frequent. In 1914 the river had one last bout of wrath and destroyed three newly made cement bridges, but since that time the Ire has no longer troubled its neighbours. It is now a lovely mountain stream with clear sparkling water, along whose banks trout fishers find their pleasure. It needs, in order to disturb it, very prolonged rainy periods or very violent storms. Doubtless it would be rash to say that it will be for ever harmless, for abundant rainfall coinciding with a rapid melting of the snow may still cause landslides too deep-set for the vegetation to check and leading to disastrous flooding, but it is probable that if the forest canopy is maintained such phenomena will no longer have the frequency which they had during the last two centuries.

If we now correlate the story of the forest with that of the torrent, the following facts are evident :—

1. The torrent was not spoken of as such until the end of the 18th Century, at the very time that the iron industry made the first heavy inroads upon the Ire forests.

2. For two centuries ruthless fellings went on, and for two centuries the flooding of the Ire was constant.

3. The ill-considered exploitation of 1858 to 1878 and 1895 to 1899 corresponds with periods of torrential action in the Ire marked by particularly disastrous floods.

4. From the end of the 19th Century up to date forms a period of reafforestation and the river loses its torrential character.

These statements are beyond dispute. There is more than coincidence between these two sets of correlated facts. Every unprejudic-

ed mind, no matter how cautious, must see between them an obvious relation of cause and effect. We therefore think that so clear an example of the arresting of torrential action by the regulation of the flow of this river deserves to be put on record.

(Translation of an article " *L'Ire et son Bassin* " by E. Graber in the March 1932 number of the *Revue des Eaux et Forets.*)

E. M. G.

REVIEWS.

JOURNAL OF ANIMAL ECOLOGY,

Vol. I, Edited for the British Ecological Society, By C. Elton and A. D. Middleton.

The increasing interest in the subject of ecology in its broadest sense is indicated by this new venture of the Ecological Society. Their previous publications have been largely concerned with plant ecology but as time goes on more and more biologists are realising that the life and development of any growing thing cannot be isolated and studied in a watertight compartment but must be considered as a part of its own environment. No matter what one's primary out-of-doors

interest is, be it trees, shrubs or herbs, game animals, birds, beetles or butterflies, the specialist must know something of the many factors in woodland life which impinge upon and influence the welfare of his particular pets. To most of our readers the tree is naturally the object of greatest interest, but we can see how silviculture as a study has developed a broader basis since it was realised that our woodlands do not remain unaltered and static, but are constantly developing either for better or for worse, according to the effects of the multitudinous factors brought into play by man and his domestic herds, the wild animals and insect life of the forest, the interaction of climate and soil physics, and the resultant development or disappearance of tree species and herbaceous cover. If we agree that the study of silviculture may gain through a sounder knowledge of the smaller plants which accompany our trees, we are forced logically to the further step of analysing the effects of the animal life of the forest, treating our woodland as a single unit in which any change in the animal life is bound in time to affect the health and even the existence of our trees. Incidentally one can see how the keen *shikari* often makes the best silviculturist for "he keeps his eyes skinned" for every change in woodland form which will give him any indication of the presence of the game he is after. If one's interest is confined to the tree tops and to height growth classification, one must work backwards from effect to cause in order to find the basic reason for altered conditions.

The first number of this journal does not contain anything about India, but several of the papers are of immediate interest in showing the lines along which the ordinary observer may work in correlating the effect of animal life upon the forest and *vice versa*. In this connection the article by Francis Ratcliffe on the fruit-bats or flying foxes of Australia is exceedingly useful in showing that although these fruit-bats' " camps " are almost invariably in the dense evergreen forest of the coastal belt, their main sources of food are the ripening seed of the *Eucalyptus*, which form very open forest or park land. In districts where the mangrove forests of the coast are absent, camps are confined to tea-tree swamps (*Melaleuca*) and creek-bed "scrubs" of *Casuarina*

or willow, but are never found in the more open savannah. These camps are occupied during the day-time and each evening they are emptied by an orderly flight to the feeding grounds, organised into main columns and scattered scouts. As the average distance between camps is about 25 miles, a flight of 10-12 miles to feeding grounds is common, and the whole territory is thus scoured by the scouts. It is thus easy to understand why no fruit can ripen or trees come into blossom within feeding range of a camp without being quickly discovered by the bats.

Contrary to the usual opinion the staple diet of these fruit-bats is proved to be not fruit but blossom. Although they attack all fruit without any pretensions to sweetness and favour especially soft fruits such as mangoes, peaches and figs, they are primarily blossom feeders and the huge fruit-bat population in Australia can only have been maintained on a diet of the periodically heavy crops of *Eucalyptus* blossom in the vast stretches of open savannah land. It is apparently only in the absence of their usual jungle diet that they make their disastrous visitations to the fruit farms.

A most useful part of the journal is the resumés of current papers on animal ecology, which naturally are scattered over a very wide field of publications which do not come to the notice of the man in the forest. The sections under which these papers are summarised are interesting in showing what a diverse field is covered by the reviewers : (1) general papers on particular groups of animals, (2) ecological surveys and habitat notes, (3) animal behaviour and the action of environmental factors, (4) parasites of animals, (5) plant galls, (6) food habits, (7) the numbers of animals, (8) migration and dispersal.

The price of this new journal is unfortunately rather high. To members of the British Ecological Society it is available for 20 shillings annually over and above their subscription, or alternately can be drawn under the membership fee of 25 shillings in lieu of the older *Journal of Ecology*. For non-members the cost of the journal is 30 shillings for the two six-monthly issues.

R. M. G.

A NOTE ON THE BURMESE SPECIES OF THE GENUS DIPTEROCARPUS.

BY C. E. PARKINSON, I.F.S., BURMA FOREST BULLETIN NO. 27.

The tangled skein of *Dipterocarp* systematic botany and the relative market values of their timbers have been brought appreciably nearer to the understanding of the average forest officer by this very able bulletin. The problem of separating them in the forest is rendered difficult by early errors in misnaming herbarium specimens and by the fact of their having tall pillar-like stems with quite unreachable crowns. They have also an unfortunate habit, like many of the *Eucalyptus*, of hybridising freely wherever two distinct species are near neighbours. From the point of view of the timber user it is essential to have them separated, as the timber of *in* (*D. tuberculatus*) differs somewhat from the red *kanyin* of *D. turbinatus* of Upper Burma, and even further from the white *kanyin* of *D. alatus* of Lower Burma. *In* is usually worth about Rs. 2 per ton more than *kanyin*, and the carpenters who use these woods can readily tell the difference in working them, although to the layman they appear alike and even the experts are hard put to it to tell which is which, as may be gathered from L. N. Seaman's notes on this very point in the July number of the *Indian Forester*.

The bulletin is well produced with clear line drawings of the leaf and fruit of the eleven recognised Burmese species, and a sketch map for each showing its distribution. These localities are based on the data noted on herbarium specimens in Maymyo Herbarium and from Parkinson's own field notes, and are only meant to give a general idea of the occurrence of each. Further systematic field work will probably show many minor alterations when the distribution of the lesser known *kanyins* has been more thoroughly worked out. In this connection there is an intriguing bespattering of question marks on several of the maps, and compared with the orderly behaviour of the other ten the distribution of *D. macrocarpus*, with small areas as far apart as Mergui, Bhamo, and the North Assam border, appears to be hardly credible. The analysis of the four common *Dipterocarps* of Cox's Bazar Division

by R. I. Macalpine in our July number agrees substantially with these species for Burma both in the botanical key and in their distribution, although in the case of *D. costatus* it seems odd that Burma should show none of this species west of the Irrawaddy.

The specific names for ten out of the eleven are those already used by R. N. Parker in his Indian Forest Records on *Dipterocarps* (XIII, Part I of 1927 and XVI, Part I of 1931), while the eleventh is the glabrous Burmese form of the Assam tree *D. macrocarpus* Vesque. The old specific names previously used by Kurz (*Forest Flora of British Burma*), Brandis (*Indian Trees*), and by Parkinson himself in his *Forest Flora of the Andamans* are correlated clearly with the names now used, so it is to be hoped that no botanical busy-bodies will start any further battles by renaming any of them afresh or immortalising himself by giving specific rank to one of the many hybrids !

R. M. G.

FOREST RESEARCH IN INDIA, 1930-31.

The Times of India of 23rd June 1932 has some interesting criticisms of this publication to offer. " This Report is printed on paper made in the Paper Pulp Section of the Forest Research Institute, Dehra Dun, from *Bambusa arundinacea* and *sabai* grass (*Ischæmum angustifolium*). This promising and learned observation at the beginning of the Report on Forest Research in India is spoilt by the paragraph immediately following, which announces that the Report covers the period from April 1930 to March 1931. That is, there is no event recorded which did not happen over a year ago, and some of the events are even two years old ; like so many official reports published in India, the Report of Forest Research in India should have been published much earlier if it was to attract public interest by virtue of topicality. But the compilers of this Report do not seem to have been at all anxious to interest the general reader ; for one thing they have set the price at Rs. 6-10-0, which is rather expensive for a paper covered book of 250 pages, and for another they have filled the pages with botanical Latinisms which altogether baffle the uninitiated reader.

One cannot help feeling that this deliberate obscurity is a mistake, for research in forestry subjects is among the most profitable and interesting research items, and in India where there are sources of wealth in the forests hitherto untouched, there are undoubtedly benefits to be reaped if forest research is allowed to proceed unhampered.

In spite of technicalities a perusal of the Report compels the layman to realise that the work carried out at the Forest Research Institute, Dehra Dun, is not only of importance to the Government but is of immense benefit to those engaged in private enterprise, and thus of economic value to the whole world. The Institute spares no pains in the conduct of experiments which throw light on the multifarious branches of forestry. For instance the Report dwells on the result of experiments in connection with the growing of *anjan* and sandalwood in the Bombay Presidency. Also as a result of the sending of two sample consignments of sawn Bombay-grown teak to South Africa at the instance of the London House of Messrs. Rhodesian Timbers, Ltd., it has been established that the high quality standard demanded and excessive freight charges militate against the establishment of commerce in teak between Bombay and East and South Africa. The Report should be of great interest to the scientist and timber expert."

There is much truth in the above criticism for there is no doubt whatever that reports have been so delayed in the past that they have lost much of their value. In this particular case, compilation has been delayed through awaiting the provincial silviculturists' reports, then a further delay of several months has occurred in the printing. For 1931-32 a report dealing with work at the Forest Research Institute only is to be issued without waiting for the provincial reports which may be published subsequently, if necessary. An introductory summary avoiding Latin names is also to be included, but it is impossible to avoid them and to ensure accuracy when dealing in detail with the progress of research work on tree species.

It is hoped, however, that the cheaper and more expeditious appearance of the next edition will serve to stimulate public interest in the many and varied problems which our specialist officers are wrestling with.

ANDAMANS FOREST ADMINISTRATION REPORT FOR 1930-31.

Further progress was made with mapping and the enumeration of trees : information of this kind is now available for 68 square miles in the North Andaman Division and 79 square miles in the South Andaman Division. In view of the change in market conditions operations are likely to be confined to the South Andaman Division for some time, and it is of the greatest importance that the preparation of a working plan for selected areas should be expedited.

Apart from laying a light railway in connection with the mechanical extraction of timber no roads or paths were constructed : inspection paths must be constructed and maintained where silvicultural operations are undertaken. 62 acres were added to the area of plantations and a further 152 acres were cleared with a view to further planting. Promising results were obtained by assistance to natural regeneration which is a more practicable proposition than extensive planting. Considerable areas of existing plantations were thinned or otherwise assisted.

As usual fellings had to be made in a large number of areas; possible interference by *jarawas*, the hostile tribe, complicates operations on Baratang island and bush police have to be provided. Most of the fellings in the South Andaman Division were given out on contract, while in the North Andaman Division they were mostly carried out departmentally.

The growing demands of the match industry and the introduction of mechanical extraction in the North Andaman Division account for 16,000 tons of timber felled as compared with 12,000 tons in the previous year. The outturn of sawn timber from the South Andaman mill was 5,183 tons and from the North Andaman mill, 5,111 tons;

a smaller outturn from the South Andaman mill was almost balanced by increased outturn from the North Andaman mill and this reflects the degree of efficiency with which the two mills worked. The wastage in sawing in both cases was 61 per cent.

The quantity of timber removed by purchasers or free grantees is inconsiderable : rather larger sales are ascribed to the establishment of saw-pits in villages around Port Blair. A large increase of timber and firewood removed free by the Deputy Commissioner was due to the requirements of the dredger engaged on the reclamation of swamps. The exports of timber fell from 25,172 tons to 23,621 tons, mainly owing to fluctuating demand for squares. The demand for logs for the match industry was maintained, and a smaller demand for sawn timber at Calcutta was balanced by increased demand at Madras: the London sales (1,193 tons) were about the same.

The profit for the year amounted to Rs. 1,98,852 and this with Rs. 1,50,993 interest charged to the accounts represents a return of 12·4 per cent. on the capital invested. This is not unsatisfactory taking account of Rs. 1,57,782 written off the value of closing stocks, Rs. 57,000 debit on account of the loss of a launch, a loss of firewood to the extent of Rs. 9,000 in connection with dredging operations, and a heavy fall in the prices of timber. Owing to trade depression there was a considerable increase of stocks of all classes of timber, but their balance sheet value is 12 per cent. less; the depreciation of stocks must continue to receive the closest attention. The loss on sales of scantlings in Calcutta was more than covered by the profit on scantlings sold in London.

The present practice of charging plantations, enumerations, and some other items of expenditure to capital account needs reconsideration : and re-valuation of much of the plant with possible simplification of financial control on the lines of that adopted for the Utilization Circle, Burma, is badly needed.

Reports were received on five timbers sent to the Forest Research Institute in 1929-30 for mechanical and physical tests. The treatment prescribed by the Forest Entomologist to prevent white chuglam timber being attacked by borers proved satisfactory.

The Inspector-General of Forests points out that Mr. Golding and his staff, and particularly Mr. M. C. C. Bonington, have earned the thanks of the Government of India for achieving results which are very satisfactory in view of the difficult conditions that prevailed. Mr. Bonington has now retired after spending a life-time in service in the Andamans; his knowledge of the islands is unique and it is largely due to his work that it has been possible to develop a profitable trade in the timbers available.

FOREST ADMINISTRATION REPORT FOR ASSAM 1930-31 AND N. L. BOR'S 1931 WORKING PLAN FOR KAMRUP.

Under the head of silviculture it is noted that the possibility of obtaining natural regeneration of *sal* in Kamrup "is no longer a matter of doubt," and as there have been other references recently to the "Assam method" or "Kamrup method" without any clear statement of what is meant, the following quotations are given from N. L. Bor's 1931 Working Plan for Kamrup:—

"The author of the last plan recognised from contemplation of the behaviour of *sal* in grass land in Kamrup, that nature's method of producing a *sal* forest was that which is going on in the grass lands of Boko before our very eyes today. The only soil covering favourable to the growth of *sal* seedlings appears to be thatch. *Sal* seedlings appear in the thatch and are burned to the ground every year and as surely make their reappearance. This goes on for many years, every year adding more shoots to those already on the ground until a stage is reached when it will grow into a *sal* forest if protected from fire. This sequence of events is now an accepted fact and the problem resolves itself into an attempt to replace the evergreen undergrowth of the Kamrup forests by thatch. This has proved to be a much simpler task than was at first supposed, for the improvement fellings prescribed under the old plan combined with late burning where the undergrowth is evergreen and by early burnings where the undergrowth is more inflammable have had astonishing success. We know that thatch

can be induced to grow almost at will. The one drawback, and an important one, is the weed *Eupatorium odoratum*, which appears to be ousting thatch in some places and in others to be going down before it. . . . .

Owing to the universal and successful fire-protection in the past the forest had become filled with a dense and often impenetrable undergrowth of evergreens which it was thought impossible to burn. Persistent attempts have proved successful and this evergreen undergrowth has to a great extent disappeared during the last ten years, leaving as the present undergrowth sometimes thatch and sometimes *san* grass. Wherever a gap in the canopy exists are to be found seedlings of the established type where none existed before and it is impossible to believe that this happy state of affairs is anything else but the result of opening *plus* burning. [" Established " is applied by Bor to seedlings of 2 years and over which will survive persistent burning ; the United Provinces " established " or " carroty " stage Bor calls the " permanent " stage.—Ed.]

It is certain that these seedlings which have survived during the present edaphic conditions will continue to live and grow if the canopy is kept sufficiently open and burning continues every year. Experimental areas, groups and strips, have been opened in many parts of the forest and it is very extraordinary how quickly the scrubby undergrowth of clear felling is replaced by thatch. It may be necessary to cut back the coppice shoots of evergreens once or twice but the fire wins in the end for its effects are cumulative. This burning must be persisted in to kill finally all evergreens and to get rid of all creepers. To eradicate creepers is a very important matter since an attack of creepers may ruin a whole area. The annual fire will kill all *sal* seedlings down to the root-stock, but the latter sends up as vigorous a shoot as before.

" It is the nature of the *sal* shoot to remain whippy for some years, it is not known for how many, before it passes into the fleshy stage. Once the seedling appears on the ground and survives one or two seasons it is believed that there is no cause for anxiety, for only very

abnormal causes over which there is no control can cause the death of the seedling. (Abnormal causes include heavy floods, attacks of insects and animals, to which must be added a normal cause, the incompetence of the staff). Areas in this way may be burned over for a sufficient number of years until the whippy established shoot is replaced by a permanent fleshy one and then, if fire protection is applied, the whole will become a sapling forest.

When fire protection is introduced in a thatch area which has been burnt for many successive years and in which many *sal* seedlings are found, it is observed that the *sal* does not at once go ahead but seems to hang back for the first year or two This is possibly due to the fact that the *sal* seedling has got into the rhythmical habit of dying back or being killed every year and requires some time to readjust itself to the new order of things. Its growth is very rapid indeed once it does start."

* * * * * * *

Assam has been able to show a small surplus, but even this much reduced credit balance has been maintained only by the most drastic economies and the curtailment of its development programme, including the dismissal of several temporary officers who had been appointed to meet the previous rapid expansion in the demand for forest produce. In the preceding five years the average revenue was Rs. 31 lakhs and the surplus $6\frac{1}{2}$ lakhs, but for the year under review the revenue is $22\frac{1}{2}$ lakhs and the surplus $1\frac{1}{2}$ lakhs, which is equivalent to a yield of 5·9 per cent.

The dull market is reflected by all divisions showing a decrease in the output of timber, the drop for the whole province being about 15 per cent., though it is to be noted that several of the commercial concerns holding forest leases show an increased output. The total receipts from timber and minor produce removed by purchasers showed a heavy drop in value, namely Rs. $14\frac{1}{2}$ lakhs as compared with $21\frac{1}{2}$ for the previous year. The demand for match-woods however continues to keep up, and the railways are using more softwood sleepers. The

Assam-Bengal Railway purchased 140,000 and actually treated 270,000 softwood sleepers at their creosoting plant at Naharkatiya. Their experiments in impregnation work have been extended and samples of the following timbers are now under treatment : *Lagerstroemia parviflora*, *Schima* spp. *Canarium resiniferum* and *Terminalia belerica*. Arrangements have also been made for the impregnation of softwood poles which are to be sold in the local markets, in order to encourage the wider use of the cheaper Assam timbers.

The report specifies separately 45,000 M. G. sleepers of *Mesua ferrea* supplied to the railway, but it is not clear if this is a new development or whether these have been creosoted or not. Some 21½ lakhs square feet of plywood were manufactured by the Assam Railways and Trading Co. at Marguerita during the year, so presumably the tea-gardens are beginning to use local wood for their boxes instead of importing them. Although the government resolution on the report states that "the depression continues and little if any improvement can be expected in the current year," the report does not by any means give an impression of unrelieved gloom, and there are many indications that this province, so rich in natural resources, is slowly but surely coming to the front, and that we shall in future hear much more about the Assam forests, both in silvicultural progress and commercial development.

Although Goalpara is recognised as the "show" division of Assam it is not generally appreciated what a huge charge it is. The fear of increasing expenditure has held up the proposal to split this division into two major and one minor charges, but two sub-divisions have been created on the lines already employed in Bengal. Even so, these sub-divisions contain 559 and 317 square miles, compared with 368 square miles of reserves for the whole of Buxa, the important neighbouring Bengal division, which is further reduced into more or less independent sub-divisional charges.

The conduct of elephant catching has been improved in the Western Circle by the introduction of a profit-sharing system in which the government, the managers of stockades, and the *koonkie* owners are

partners. After a lapse of 8 years, operations were undertaken in the North Cachar Hills under Babu B. C. Sen, E.A.C.F., and a total of 113 elephants were caught, partly by *mela shikar* and partly in stockades. Out of these, 80 unsuitable animals were released and from the sale of the remainder government's share amounted to some Rs. 62,000 against an expenditure of less than Rs. 6,000, so that in these hard times this must surely be regarded as a very profitable venture. In the Eastern Circle also elephants proved a useful source of revenue, a nett bag of 65 animals yielding a revenue of over Rs. 19,000.

The question of poaching is receiving much attention, by no means too soon when forest subordinates have been repeatedly fired at by poachers. A rhino horn is now worth about half its weight in pure gold in the open market, and in the Surma Valley there is an organisation for financing rhino poachers. An additional and very cogent reason for dealing sternly with these gentry is that they object to the fire protection which is now of basic importance in Assam silviculture so that if silviculture is to flourish by means of a carefully regulated programme of controlled burning or rigid protection, poachers must obviously be discouraged from making bonfires to suit their own nefarious purposes. A useful step in this direction was the introduction of a detachment of Assam Rifles who spent six weeks in North Kamrup. The offending Cacharis and Meches naturally enough buried their unlicensed guns and kept very quiet during this visitation, which doubtless had a sound moral effect.

In addition to the trade in real rhino horn ; there is apparently a flourishing business in fakes, for the local Marwari dealers have been "sold a pup", first with bamboo roots blackened to look like rhino horn, and later when they had learnt about the bamboo root trick, with faked pieces of buffalo horn ! The Pyinmana Forest School Museum boasts a fine collection of rhino horn fakes found in Burma, so it would be interesting to know where this trade in bogus horn first originated.

R. M. G.

FOREST ADMINISTRATION REPORT FOR BURMA, 1930-31.

We have no luck in our choice of reviewers. This report was sent to a reliable authority but was returned with the remark that there was nothing in it to review. From the editor's point of view are we to cause less offence to the staff of the largest province by repeating this or quietly consigning this report to the last page limbo of "publications received"? We choose the former horn of this horrid dilemma, and to cover our confusion we quote verbatim the Government of Burma Resolution on the report :—

> "The Chief Conservator of Forests, officers and subordinates of this important department are to be congratulated on another successful year's work despite the restrictions entailed by the financial stringency of the province and by the disturbed conditions. Tharrawaddy and Insein Districts in which the rebellion broke out, Prome, Pegu and Toungoo to which it extended later, are very important centres of forest activities, and owing to the remoteness of their operations employees of the department in these and other areas were peculiarly exposed to rebel attack. The Government of Burma (Ministry of Forests) desire to take this opportunity of expressing their regret at the casualties detailed in paragraph 136 of the report and their appreciation of the very valuable services rendered in all affected areas by all ranks of the Forest Department, subordinates as well as gazetted officers. Their local knowledge has been of the greatest use to civil, military and police officers, and many of them have actively assisted in the suppression of the rebellion at considerable danger to themselves."

The casualties referred to were : -

Killed : Mr. H. V. W. Fields-Clarke, Forest Engineer ; Forest Ranger Maung Ba Yin ; one deputy ranger ; one forester ; one camp clerk ; one mahout.

Wounded : Mr. E. H. Peacock, Deputy Conservator ; one *chaungok* ; and one rest-house keeper.

In our July number we published the names of several Burma officers who had been decorated for their services during the rebellion,

and it is good to know that their work has been thus recognised, but this credit balance is very little to offset against the loss of valuable lives, the widespread destruction of Forest Department buildings and property worth over a lakh of rupees, the cessation of all constructive forest work over wide areas, and an enormous loss of revenue from the continued interference with timber work which the rebellion brought about.

R. M. G.

EXTRACTS.

THE COLONIAL FORESTS AND THEIR STAFFS.

As will be remembered, one of the problems considered by the first Empire Conference of Prime Ministers which met in London was the question of forestry in the Empire and the method by which a common and consistent forest policy should be formulated and adhered to afterwards by the individual parts. Empire settlement in connexion with forestry was one of the aspects to which attention was given. These matters were fully considered by a Forestry Sub-committee which was set up.

One of the dangers inherent in a problem of this type is the almost inevitable prominence given to the utilization side of the question, obviously the best understood, and, it may be added, the best propaganda, when forests and forestry are in question. An examination of the memoranda and reports published displays the rather overwhelming preponderance given to the question of the world's timber supplies and the possibility of the Empire (*a*) becoming more or less self-sufficient in timber supplies, (*b*) developing larger export markets of her tropical timbers. It was recognised that there existed social and economic problems which necessitated each country in the world formulating a policy which should maintain a sufficient area of forest under a conservative management; and this recognition has been growing in force amongst those administrators and specialists who have given attention to this matter in the British Empire. Important, however, as the question of the world's existing resources in timber undoubtedly is, the accompanying and correlated one—the protection from needless destruction of the world's remaining forests, especially in the tropical and subtropical regions, and their proper management is equally imperative. On three separate occasions this matter has been brought up at meetings of the British Association—in 1850, 1920, and 1926; whilst serious consideration was given to it by foresters interested in tropical forestry at the World's Forestry Conference in Rome in May 1926 (*vide* NATURE, Jan. 8, 1927).

As an outcome of the Oxford meeting of the British Association in 1926, Lord Clinton, chairman of the Forestry Subsection, drew up for the Council a short memorandum discussing the destruction of forests on hill slopes, with the well-known after-results, with especial reference to the tropical forests of the Empire. There was nothing new in this memorandum. The subject had been brought up before. But in the hands of so able a man as the chairman of the Forestry Commission it was believed that the question would receive a sympathetic consideration. The Clinton memorandum was submitted to the Secretary of State for the Colonies, by whom it was communicated to the governors of the various protectorates and colonies.

There was apparently no longer any doubt in the minds of the responsible authorities at the Colonial Office, as there could not have been in those of the Sub-committee of the Empire Conference, that certain practices to which a considerable proportion of the tropical forests of the Empire were still exposed should be stopped, or, at the least, efficiently regulated. The best known of these, by which annually the forests so treated are losing their value or being threatened with total annihilation, are shifting cultivation, excessive grazing of domestic stock, and the annual firing of the forest lands,

As, after the War, the Colonial Office had commenced to recruit trained men for all the various local forest services in the dependencies under that Office, there did not appear to be any reason why the action taken in 1926-27 should not at length meet with a decided and firm response from the several local administrations responsible for these valuable, and in many cases as yet commercially untapped, tropical forests. It may be stated at once that genuine attempts were made towards taking steps to give effect to the Secretary of State's wishes in this matter. Moreover, there were one or two young services which had been inaugurated since the War in which there was no lack of eagerness to commence the steps necessary to grapple with the unchecked and improvident habits of the local populations.

It would be impossible to discuss here the differences which obtain in the ownership, methods of local utilization, and so forth, of these tropical forests. These vary with colony and dependency. But there is no, or little, variation in the results of the increasingly rapid destruction and deterioration of the forests exposed to the practices above-mentioned. As was seen in India, where formerly a similar state of affairs existed, (and which still exists in many parts – Ed.) no forest service in the world can attempt successfully to introduce measures for the regulation, control, and eventual suppression of these injurious acts unless it is strongly supported by the civil authority and, nowadays, by the governor's legislative council, which body will include a number of non-official members.

There can be little doubt that the result of the active and far-sighted policy of the Colonial Office during the last decade has brought the forests of the protectorates and colonies into a prominent position, and that there now exists throughout the country some knowledge of their importance; and also of possible careers for active young men who make themselves efficient by a university training. To this point it may be said, therefore, that recognition has been given to the *need* for the conservation and effective management of the Empire tropical forests. But has effective action, necessary in every colony, been taken? Has a forest staff of sufficient strength been recruited? Mere lip service to a recognition of the perils to which a colony will be exposed by the further unchecked destruction of its tropical forest areas, or important sections of them, will not stop the sacrifice; and, each year it is allowed to continue, the destruction, with erosion, etc., proceeds at a greater rate.

Owing to the world-wide financial stringency, government staffs, as also commercial staffs, are so far as possible being reduced and recruitment has been kept at the lowest possible minimum. In the case of the colonial services, the forests have been treated on the same basis as other departments. It may be asked, is this policy, even though the forest department budgets are showing a temporary deficit (for adverse trade immediately reacts on forest receipts), correct or even sound, in the case of a colony possessing capital in the form of undeveloped forest areas subject to abuses and deterioration? Even while admitting that every sound effort should be made towards retrenchment, if the wishes and sentiments expressed by the Empire Conference and ministers on the matter of stopping the long-continued destructive practices of the populations living in, or in the vicinity of, tropical forests were anything more than a pious expression of opinion between 1924 and 1927, how has the position changed?

It would appear to be even more vital the more so since a perusal of the annual reports of the heads of the various forest departments in the colonies and dependencies for the past six years or so will disclose an almost unanimous complaint about the paucity of the staff and the necessity of strengthening it if real conservation was to be introduced ; though in a few cases there has been a considerable expansion. In how many of these colonies is the practice of shifting cultivation as rife as it was twenty years ago ?

These queries are not put with any idea of a criticism of the Colonial Office authorities. Far otherwise, as will appear. In a recent article on " Forests and the Economic Crisis " in the *Empire Forestry Journal* (Vol. 10, No. 2, 1931), Sir Roy Robinson deals with what he aptly expresses as the blizzard blowing over forestry. Sir Roy asks what foresters can do, and enumerates five points, covering inaction or action. In one of these he says : " If Forestry has proved an easy subject for drastic cuts it is because it had not made sufficient friends. In other words, our educational effort has not yet borne the desired fruits." It would appear that Sir Roy is regarding the matter chiefly from the point of view of forestry in Britain, where, apart from administrators and politicians, an educated forestry opinion in the public would be a strong asset. The position is, however, very different in the case of colonial countries, where an educated public opinion is non-existent, and where the point of view of the administration is the only one to be taken into account. Moreover, Great Britain does not possess any capital in the shape of large areas of undeveloped forests, which is commonly the case in the colonies.

This being so, the fact remains that in spite of the full recognition given to the importance of putting a stop to the destruction of tropical forest, a step which is only possible by having a strong forest department in the colony and backing it up with full official authority, forest staffs are actually being reduced, in a most drastic fashion, and recruitment stopped. In other words, in the interest of a perfectly understood and implicitly believed-in campaign of retrenchment, the development of the capital resources of a colony are being put back by a decade, whilst parts of the capital are subject to annual depreciation. Several instances could be quoted. The case of British Honduras present some exceptional features and may be regarded as an extreme case ; but it has the merit of exhibiting the problem in a manner calling for no expert knowledge upon which to base an opinion.

It is common knowledge that mahogany has been exported from British Honduras for several centuries. Not before 1922 was a small forest department inaugurated. Four years later this young department had six trained officers, the administration being placed under a Forest Trust. The forests were chiefly worked by lumbering companies on leases from government. The young department worked in well with the old methods and had begun to make a most promising headway. The *dénouement* exemplifies the purpose of this article and the question implied.

Should a financial deficit in a colony possessing considerable areas of undeveloped valuable tropical forest, at present subject to annual and increasing destruction, justify the abrupt stopping or serious checking of the work in hand or urgently needing being taken up ? The following shows what has happened in British Honduras :

Owing to a falling off in forest revenue, the Unofficial Members of the Legislative Council signed a petition on Jan. 22, 1929, praying for a general curtailment of the forestry programme and reduction of Forest Trust expenditure. This petition, with comments by the Governor and his advisers,[1] was submitted to the Secretary of State for the Colonies, Lord Passfield. The reply was as follows, and is very instructive :[2]

" In another connection the attention of the Secretary of State had been brought to the disquieting probability that the revenue derived directly and indirectly from forest products will suffer very serious depletion at no distant date. For this reason, in addition to those adduced by the memorialists, he is convinced that the present structure of the Forest Department is heavier than the Colony's economic framework can sustain.

" At the same time, his Lordship is unalterably opposed to any amendment of the legislation governing the constitution, finance, and duties of the Forest Trust. British Honduras has depended upon its forest resources for 300 years : the approaching crisis in output will prove, it is earnestly to be hoped, of temporary duration : and the justification for providing machinery to regulate scientifically, so far as may be, the natural wealth of the Colony is as self-evident now as it was when his predecessor directed the creation of the Trust. His Lordship has accordingly reached the conclusion that the solution of the present financial difficulty is to be sought, not by altering the status of the Trust, but by curtailing its activities and consequent expenditure to the minimum consistent with the discharge of its routine duties, the preservation of its records, and the maintenance of the valuable experimental work already in hand. The adoption of this policy will ensure that when conditions justify the re-enlargement of the scope of the Trust, the nucleus of personnel and the knowledge and experience accumulated will be ready to hand........ His Lordship ventures to express the hope that the Unofficial Members of the Legislative Council will exercise the foresight which their position as guardians of the Colony's destinies demands and will lend their willing support in the policy here outlined."

These orders involved a cutting down of the staff, several officers being transferred elsewhere ; the loss of the experimental sylvicultural work of great promise which had been commenced, for such work is doomed without the eye of the trained officer upon it ; and the postponement of the opening out of considerable areas of unknown forests in this Colony.

Lord Passfield may be congratulated on his firm attitude Nevertheless, until it is recognised that a temporary fall in revenue in the case of inadequately staffed forestry departments should not be met by cutting down expenditure, staff, and so forth, no efficient or rapid progress can be made in the development of potentially rich but imperfectly known forest areas ; whilst the delay in introducing an efficient check on indiscriminate acts of destruction is yearly reducing the value of this often irreplaceable asset.

[1] British Honduras. Report of the Forest Trust, 1930. Belize, 1931.

[2] Reply to Petition by the Acting Colonial Secretary, dated Belize, Oct. 9, 1929

This view of the matter finds strong support in a question connected with Empire timber supplies. In the annual report of the Forest Products Research Board of the Department of Scientific and Industrial Research, the increased interest of the public in Empire timbers is commented upon. The writers, however, stress the opinion that the joint work of the department and the Empire Marketing Board was not in itself sufficient to cover the necessities of achieving a general development and national use of Empire timbers. Unless production and marketing are closely co-ordinated with research, the work of the Board will be impaired. Amongst their suggestions, the one " that some enlargement of the facilities at the disposal of the Forest Services " is timely. It appears obvious that if production, marketing and research are to be efficiently co-ordinated, the first step is to go to the fountain-head and maintain or appoint a forest staff of sufficient strength to manage effectively the tropical forest areas in the several colonies.

(*Nature*, 11*th June* 1932).

FRIDERA.

The Indian Railway Board have just published a technical paper written by S. Krishna, Ph.D., D.Sc. (Lond.), F.I.C., Biochemist, and T. P. Ghose, B.Sc., Assistant, Forest Research Institute, Dehra Dun.

The subject-matter will be of special interest to Railway Engineers in general and more particularly to those who have the maintenance of the road under their charge. The outcome of the Forest Department's research work seems likely to be the means of effecting very considerable economy in sleeper purchase for the railway, in so far that " Fridera " will allow the sleepers to be used until decay sets in, instead of the life being determined by the number of times the spikes can be driven. This compound " Fridera " is used for filling up the spike holes and thus securing a new and efficient grip for the spike. The history of the experiments patiently carried out, the many failures and ultimate success, are told in a very interesting manner which will grip the attention of even the layman in such matters. The pamphlet may be had from the Government of India, Central Publication Branch, Calcutta, the cost being As. 6.

(*Indian Engineering*, 18*th June* 1932).

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FORESTRY EDUCATION IN INDIA.

October 1932 will mark a reduction in the activities in forestry education at Dehra Dun, for with the end of this term the I. F. S. College is to be closed down indefinitely and the Rangers' College with no new junior class starting will be considerably smaller. It is, therefore, a good opportunity to consider plans for the future.

These reductions are directly due to the universal need for economy, because most provinces complain that their forest service cadre is too expensive and wish to curtail recruiting until better times. In the case of the I. F. S. College it is also indirectly due to political developments, for with the prospects of being able to recruit their own officers at a cheaper rate for the proposed Provincial Service, Class I, the provinces naturally do not wish to recruit any more officers at the existing I. F. S. rates. There are, however, other and more important implications to be considered than a small reduction in the cost of staff, for the future well-being of the whole of our forest service depends upon the selection of the right type of recruit; and upon his early training.

The I. F. S. College was started in 1926 in the hopes of establishing a tropical forestry school which would attract students not only from the whole of India and Burma, but also from Malay, Siam, the East and West Indies, and possibly other tropical and semi-tropic countries. A beginning had already been made in this direction with the previous Provincial Service Course, with its average of 12 students a year from 1912 to 1926, a few of whom have gone to Trinidad, F. M. S., and the Gold Coast. The standard of the I. F. S. Course, however, has not only failed to attract any outside students but has lost the

support of Burma, whose Class I officers are now being trained at the Oxford School of Forestry and Class II at Rangoon University. The result is that the attendance at the I. F. S. Course has averaged less than 5 per class for the six years it has been in being. Are we to conclude that this attempt to train Indian officers in India has failed? This cannot be proved or disproved by the number attending, but will be judged on the eventual success or failure of its students as practical forest officers. It can, however, be taken as a clear indication that there are too many higher standard forestry schools, a conclusion already forced upon Britain and the United States and evidenced by the recent decision to close down Cambridge as a forestry training centre. Owing to this keen competition the high hopes of establishing at Dehra Dun a tropical forestry school of wider interests and international standing have failed. The I. F. S. Course has, however, served a useful purpose in turning out a limited number of trained recruits for the few Government and State vacancies which have occurred. Whether a better or cheaper training can be arranged by sending selected probationers to the Oxford School of Forestry or by re-opening the I. F. S. College at a later date will have to be decided by Government.

For guidance in this problem we recommend very strongly a study of the recently issued report of a committee under the chairmanship of Sir James Irvine, the distinguished Principal of St. Andrews' University, on "The Training of Candidates and Probationers for Appointment as Forest Officers in the Government Service." In this a committee of notable and experienced educationists and foresters have insisted upon a central training ground with a four years' course. Dehra Dun can provide as good practical forest training and specialised study of the allied research branches as can be found anywhere in the world, but it lacks the wider culture which can only be provided in the older universities, and this doubtless explains why most forest services continue to pick their recruits from men trained in British University Forestry Schools and give them a final year of study at the Imperial Forestry Institute, which is run in conjunction with the Oxford School of Forestry.

In view of the quite understandable anxiety of many Indians to support and encourage indigenous educational centres, we hope that the I. F. S. College will be reopened at a not too distant date. If and when this takes place we trust that the Irvine Committee's advice will be remembered, particularly in making the course longer—(a minimum of *four* years is laid down compared with Dehra Dun's two years) and in allowing more time for wider reading instead of the present practice of intensive spoon-feeding by means of a very full schedule of lectures. An alternative would be to allow probationers to do their full course of study at Oxford along with the Burma and Colonial Service recruits and then to give them a short course at Dehra Dun to study practical forestry under Indian conditions before being posted to their respective provinces.

Whatever steps are taken to train the future recruits for our forest service, we sincerely trust that those responsible will keep in view the wise recommendations of the Irvine Committee emphasizing the broadest possible method of selecting probationers, not on the basis of examinations but on the fundamental qualifications of a sound mind in a sound body, with a temperament and tastes which will help a man to face a life of loneliness and hardship. "We attach great importance to the possession of a strong and disciplined character, powers of initiative and self-reliance, imagination and sympathy, a keen sense of justice, observation and tact in dealing with colleagues and subordinates, good presence, address, and manners,"—characteristics which can hardly be tested either by examination papers or a medical inspection. With a mere handful of students isolated as they must be at Dehra Dun from the wider contacts of university life, it becomes exceedingly difficult to work up any corporate spirit or *esprit de corps,* so that for any future class at Dehra Dun it becomes more than ever essential that the preliminary selection should sift out the right type of officer.

We trust that the new arrangements for selecting and training forest recruits will not be delayed unduly, for it is essential that we should have a regular supply of trained officers of the right stamp if the Indian Forest Service is to maintain its fine record of unobtrusive

but devoted attention to duty. On a wider basis also we need men with a sound scientific outlook to guide and influence the first attempts at democratic government. More and more the governments of the older democracies are coming to depend upon small committees of experts for guidance in the difficult paths of modern administration. The Industrial Parliament visualised by Captain H. Macmillan, M. P., shows the extent to which the modern state is to be governed by a series of groups of experts linked up to make the most effective use of their country's resources for the general welfare. In their position as controllers of one quarter of the total land area of the Indian Empire, the members of the Indian Forest Service in the future must be prepared to take their share in guiding popular opinion in all matters affecting this vast forest estate. It is thus more than ever essential that there should be a steady recruitment of young officers upon whose professional integrity and standards of qualification the rulers of this country may depend.

SCRAP THE LOT.

BY W. R. MARTIN, I.F.S.

Much has been said, little has been written, and almost nothing has been done towards solving the problems of natural regeneration in tropical evergreen forests. I am writing particularly with reference to Upper Assam, but the Proceedings of the Silvicultural Conference held at Dehra Dun in 1929 reveal that in this matter at least Assam has reached the same stage of advancement as other provinces with a similar problem, which means that she has not yet started.

We Assam foresters are a timid tribe, and claim but distant kinship with the giants of the U. P. and the Punjab. Sometimes a distinguished cousin, or the super-distinguished uncle, from the forest Metropolis visits us, and we feel like the lady in the American advertisement for a deodorant mouth-wash who smiles inanely and covers her mouth with her hand, lest the opening of it should prove her undoing. And so when our eminent kinsmen visit us we are discreetly

silent as we listen to their words of wisdom. But their visits are so rare, and so few of the wise words deal with our greatest problem, that it seems time we pushed discretion overboard and made ourselves heard. Let us start by asking two questions:

1. Do we know what exactly we are aiming at when we speak of naturally regenerating our tropical evergreen forests?

2. Is there any considerable area of this type of forests, adequately stocked with saleable timber species, which has resulted by natural regeneration from something resembling the average Assam evergreen area, at a cost which is financially admissible?

Let us examine the first question. In the years 1920-21 an enumeration survey was carried out over what are possibly amongst the best plains evergreen forests in Assam -the forests of the Sadiya Frontier Tract.

The classification was based on the number of marketable stems per acre of six feet and over in girth, and the results were as follows:

		Per cent.
1st class, containing 7 or more stems per acre	..	1·74
2nd class, containing 5 to 7 stems per acre	..	4·41
3rd class, containing 3 to 5 stems per acre	..	18·19
4th & 5th class containing less than 3 per acre	..	75·68

The species enumerated included *Terminalia myriocarpa*, *Lagerstroemia flos-reginae*, *Cedrela toona*, *Amoora wallichii*, *Cinnamomum cecidodaphne*, *Morus laevigata*, *Duabanga sonneratioides*, *Bischoffia javanica*, *Gmelina arborea*, *Artocarpus chaplasha*, *Albizzia procera* and *Chukrasia tabularis*. I think, but am not certain, that *Bombax malabaricum* was also included.

The above figures show that approximately 25 per cent of the forests enumerated contained three or more nature stems of saleable timber species per acre, and might be expected to give a yield of possibly 250 cubic feet per acre. The areas falling within classes 1 to 3 formed reasonably compact blocks, and it will be convenient if we consider only areas of this quality.

When as enthusiastic natural regenerators we carry out selection fellings in forests of this kind, and perform all other operations

prescribed for the assistance of the young growth which results, is our aim to perpetuate this yield of 250 cubic feet per acre every twenty-five years ? Or if we aim at something better, when do we expect to achieve it—after one rotation, or two, or ten rotations ?

In the year 1928-29 the volume of timber exploited in the Sibsagar Division, of which I am now in charge, was approximately four lakhs cubic feet, the greater portion of which came from Unclassed State Forests. But this source is rapidly dying up, and in a few years the entire timber demand will have to be met from forest reserve. Even if we assume optimistically that only areas similar to the first three classes in the Sadiya forests are worked—that is, areas giving a yield of 250 cubic feet per acre—it will be necessary to cover no less than 1,600 acres per annum in order to meet a demand of four lakhs cubic feet.

Our difficulties, however, will not by any means end there. The cultural operations preceding and following exploitation will involve a considerably greater problem. Assuming that it were necessary to go over each area only five times in a period of 25 years—once for climber cutting, a few years before exploitation, and four times for tending subsequent to exploitation—the annual area to be treated would be approximately 8,000 acres. The enthusiastic Divisional Forest Officer who controls it will certainly get his exercise !

But I think one is entitled to ask where it is going to lead us. If at the end of a rotation the doing of it has raised a class 3 area, with a periodic yield of 200 cubic feet per acre, to class 2, with a yield of 350 cubic feet, shall we be satisfied ? I can picture the succession of forest officers who will have been responsible for it looking down in years to come upon their handiwork from the folds of Abraham's bosom, and claiming that by tender and intimate care bestowed for more than a century they achieved this. Then I can see some gross financier who will have managed to evade the turnstile approaching with the irreverent enquiry : "Yes, but how much did it cost ? " To that there will be no answer, just a look of withering scorn which says : "How cometh this fool here ? Knoweth he not that the immortals measure not cost but achievement ?"

Broadcast Strip departmental plantation of *ajhar* (*Lagerstroemia flos-reginae*), fifteen months old. An occasional *Terminalia myriocarpa* plant can be seen in the right-hand line.

I have no wish to quarrel with the immortals. They are probably right. But the trouble is that our legislators have not yet acquired immortality (nothing sinister is intended), nor the immortals' outlook in practical affairs, so we are forced to take a more material view.

I feel sure that there is one other question the financier would have liked to ask had he not been frozen into silence : " Was it worth it ? " Since no answer is likely to be forthcoming from the immortals I shall venture to give one. It was not. As a silvicultural achievement it may have been admirable, but from any other point of view it very definitely was not " worth it."

Having now almost certainly committed the indiscretion of offending the immortals I must attempt some justification of my rashness. The financier's question is a perfectly legitimate one. Those who advocate any particular policy should be in a position to show that it is likely to achieve the objects aimed at at least as fully as any alternative policy. In the forests which we are discussing the objects of management may be briefly defined as the attainment of the maximum sustained financial yield consistent with the maintenance of adequate provision for the present and future timber needs of the province.

We must, therefore, be patient with the financier when he asks : " Was it worth it ? " Answering for the immortals let us tell him that we have collected the income from four periodic yields of 200 cubic feet per acre each, and that though the income was small, on account of the high costs of very scattered working, the treasury was grateful for it. But we have had to meet very heavy charges in connexion with road construction and maintenance, cultural operations and supervision, and our income has all been absorbed. We have however improved the forest, and look forward to a future periodic yield of 250 cubic feet, while perhaps at the end of another hundred years we may have increased it still further to.................................

But it is no use proceeding. The financier has gone away shaking his head and muttering something about returns on capital. If I

have suggested the correct answer to the first of our two questions the financier would tell us very emphatically that natural regeneration is not worth being after: and I am quite sure that he would be perfectly right.

In defining the objects of management of the forests under discussion I used the expression "maintenance of adequate provision for the present and future timber needs of the province." The prosperity of Assam is intimately bound with the tea industry, and it is probably safe to say that so long as tea continues to be drunk Assam will produce it. At present the production is 240 million pounds per annum and every hundred pounds requires a tea-chest. There are therefore 24 lakhs of tea-chests used every year in Assam, and at the most four lakhs (including shook boxes) are produced in the province. The remainder are imported from abroad.

The volume of timber required for the manufacture of a three-ply tea-chest is approximately one cubic foot (actually it is somewhat more, but with well-grown timber it need not be). Thus, approximately 20 lakhs cubic feet of timber are imported annually into the province in the form of tea-boxes alone.

Two veneer factories for the manufacture of three-ply chests exist in Assam, and they are unable to compete economically against European factories which send their goods seven thousand miles by sea, and pay an import tariff into the bargain. There are various reasons for this; but the principal one, and the one with which we are concerned at present, is the inferiority of our forests. Every good timber does not make a good tea-box. Uniformity is essential. We cannot supply white boxes to-day, brown ones to-morrow, and red ones the day after, and expect the various tea interests through whose hands they pass to be satisfied. Tea-tasters have wonderful noses and wonderful palates, and they are certain to discover that any box which deviates in colour or texture from the one they are accustomed to imparts an injurious flavour or odour to the tea contained in it, however *innocent the box may be!* One of the Assam factories (I cannot speak for the other one) uses only

Terminalia myriocarpa ; and it is probably correct to say that the workable forests at its disposal do not contain more than 150 cubic feet per acre of this species.

In the second of the two questions which I asked at the outset I enquired whether there was any considerable area adequately stocked with saleable species which had resulted by natural regeneration from the type of evergreen forest that we are familiar with in Assam. It is necessary to explain what we mean by *adequately* stocked.

Assam's greatest forest need is the creation of permanent timber resources which will enable her to supply the twenty lakhs cubic feet of timber which come into the province every year from abroad in the form of tea-boxes. Any yield which will not enable her to do this is clearly not adequate. The perpetuation of a yield of 150 cubic feet per acre is useless. The raising of it—if it can be raised—to 500 cubic feet at the end of a century, or two centuries, is also useless. We must have an industry which can stand on its own legs without being bolstered up by protection and royalty concessions, and this cannot be achieved unless concentrated working, with enormously reduced costs, becomes possible. If Assam is ever to possess by fair economic means the enormous permanent market that exists within her own borders we must make up our minds to the fact that, so far as this market is concerned, her existing forests are worthless ; and that no form of treatment which has yet been devised, dependent on natural regeneration, and subject to normal financial limitations, will ever make them anything else. What are we going to do about it ? We shall have made an excellent start when we decide to " scrap the lot."

The immortals have laid aside their nectar horns and are looking puzzled and disturbed. I see the shaking of ancient beards and seem to hear the words " What meaneth this talk ? Hath silviculture come to be a thing of markets and commerce and wheels and dynamite ? Was not he that speaketh admitted to the fellowship of our sacred craft through an ancient academy ? How hath he thus turned Philistine ? Strong sunshine hath doubtless made him mad."

I fear I have now definitely " torn it " with the immortals. There is one consolation however. They blame it on strong sunshine,

Strong drink would have been worse. Perhaps, however, I have been a little rash, and I hasten to explain that my prescription is not intended to be quite so violent as it sounds. Let me try to make it clear.

Our first aim should be to build up forest resources which will enable us to capture the entire tea-box market within the province, and, having captured it, to hold it permanently. Our boxes must be uniform, therefore we must stick to those species which are known to be suitable. I think it can be accepted that the most suitable species in Assam for the manufacture of three-ply tea-chests is *hollock* (*Terminalia myriocarpa*). Let us then fix our future requirements of this species at 25 lakhs cubic feet per annum in, say, three centres. Any person who has seen the results of the artificial regeneration of hollock undertaken in Upper Assam in the last ten years will I think have been convinced that a yield of 6,000 cubic feet per acre—an intermediate yield of 2,000 cubic feet from thinnings, and a final yield of 4,000 cubic feet—on a sixty years' rotation is not unduly optimistic.

Provided that plantations are created in the right way there are probably few timber species in India which can be grown with greater ease or at less cost than hollock. In 1924 the writer first introduced in the Sadiya Division, of which he was then in charge, the method of sowing this species broadcast over prepared lines. The density of sowing was somewhat greater than that in which oats are sown in England, the object being to create a carpet of seedlings which would take possession of the ground at an early age and exclude weeds within the lines.

The method was so successful that it was applied to a block of 90 acres in 1925 with equally good results. In 1927 it was introduced in this (Sibsagar) Division, and has since been continued annually with unfailing success. This year the area taken in hand is 150 acres, while last year one hundred acres were sown. The method has been named the "Broadcast Strip" method.

So far the only species sown in this way have been *hollock* and *ajhar* (*Lagerstroemia flos-reginae*). Both of these are multi-seeded species, and seed can be collected for about one rupee per rice sack.

Broadcast Strip departmental plantation of *hollock* (*Terminalia myriocarpa*) twenty-seven months old.

When sowing is done in lines six feet wide and fourteen feet apart (*i.e.*, twenty feet from centre-to-centre) the quantity of clean seed required is approximately one sack per acre.

The plantations undertaken have been partly *taungya*, with sugarcane as a field crop: and partly departmental, without any field crop. In both cases, after the removal of all saleable material, the area to be treated is clear felled and burnt: and the lines are lightly hoed before sowing is done.

The procedure adopted is as follows: In *taungyas* after all saleable material has been removed the area is handed over to the cultivators who during the first two years when their own crop is on the ground are responsible for all operations other than the actual sowing. Clear felling and burning are usually completed early in March. Lines are then marked out and lightly hoed over the required width of six feet. Sowing is done towards the end of March or early in April by forest guards, and care is taken to see that the seed is distributed over the entire width of the lines. After completion of the sowing the cultivators plant their sugarcane in the 14 feet wide inter-lines.

In areas infested with *Ageratum* burning should never be done until after the seed of the latter has fallen. This ensures the destruction of any which may have fallen on the plantation area. The completeness or otherwise of the burn is an important factor in determining the amount of weeding necessary during the first rains. Given a good burn, good seed in adequate quantities, and favourable weather the seedlings will come up at intervals of two or three inches all over the lines, and within six weeks after sowing will have taken entire possession, forming a regular carpet and rendering further weeding within the lines unnecessary. But unfortunately one or other of these factors is usually absent—the most uncertain one being the weather. A downpour of rain in April may wash a good deal of the seed away, or a drought after germination may kill half the seedlings. In actual practice therefore the end of the rains is usually approaching before the plants have so closed up that weeds within the lines can no longer compete.

Departmental areas are treated in precisely the same way, but the work has to be paid for; and as there are no field crops the inter-lines become overgrown with tall grass and the usual evergreen rubbish. It is important to realise however that this latter does not harm provided it is not allowed to fall over on the lines of plants. Ordinarily two weedings are required during the first rains before the plants have closed up in the lines, and a third is sometimes necessary towards the end of the following cold weather in order to give the plants a clean start when the next growing season commences.

During the second rains no weeding or cleaning is done, and the plantation presents an exceedingly neglected appearance to a casual observer. The inter-lines contain a mass of weeds from six to twelve feet high which press hard against the lines of plants, but the latter have their heads free and put on surprising height growth. There is actually no weed competition within the plant lines, and the mass of jungle in the inter-lines effectively prevents the development of side branches.

Plate 27 shows an *ajhar* plantation of thirty acres in the Hollongapar Reserve, sown in April-May 1931 The photograph was taken on the 3rd August 1932 when the plants were fifteen months old; and to make the taking of it possible the jungle in the inter-lines was cut for a short distance. The density of the plants can readily be seen, and their height is from 8 to 10 feet. No tending of any kind has been done since September 1931.

During the cold weather following the second rains the treatment given consists in cutting or breaking back the edges of the growth in the inter-lines where it presses against the plants. No attempt is made to clear this as most of it will be killed off during the next rains by the plants themselves. All that is necessary is to free the lines and give the plants a free start at the commencement of the growing season.

Plate 28 shows a *hollock* plantation in the Hollongapar Reserve sown in April 1930. The photograph was taken on the 3rd August 1932; and, as before, the growth in the inter-lines was cleared for a short distance. This plantation is now in its third growing season and the

Broadcast Strip *departmental* plantation of *hollock* (*Terminalia myriocarpa*) with *ajhar* (*Lagerstroemia flos-reginae*), three years and three months old, after first thinning.

plate shows the extent to which the plants have closed over the inter-lines. By the end of the current growing season they will have done so completely.

No weeding has been done in this plantation since the autumn of 1930, but in March of the present year an amount of Re. 1-8-0 per acre was spent in cutting back the edges of the growth in the inter-lines where it pressed against the plants. The first thinning will be done next cold weather, and at the same time all growth in the inter-lines will be cut.

Plate No. 29 shows the 1929 mixed *hollock* and *ajhar* plantation in the Hollongapar Reserve. Thinning and clearing of growth in the inter-lines, was done in March of the present year. Before the taking of the photograph on the 3rd August the undergrowth was cut for a few feet in front of the camera, but apart from that nothing has been done since the cold weather. The large stems are all *hollock*, but there is in the lines a light under-storey of *ajhar* about 12 feet high. This can be seen behind the man on the left of the picture. It may be of interest to note here that some of the *ajhar* plants in this area although only three years old, are bearing seed this year. Such plants, however, are at the end of plantation lines where they are fully exposed to the light.

Objection may be taken to the extent to which the outer poles in the lines are leaning, but this is really of little importance as the next thinning will probably remove most of them. The poles in the centre of the lines are straight. A point which is of great importance is the almost complete freedom of the stems from side branches. If this timber is used, as I hope it eventually will be, in the manufacture of three-ply tea boxes, it should be possible to cut it down on a lathe to a diameter of four inches before any knots are encountered. That will be a wholesome change from the material which veneer factories in Assam have to deal with at present.

Plate No. 30 shows the 1927 *hollock* and *ajhar taungya* plantation in the Sola Reserve. Thinning in this area was done in the spring of 1930 and nothing whatever has been done since. The photograph

was taken at the end of March 1932 when the trees were almost leafless. The cleanness of the stems and the absence of heavy undergrowth should be noted. The *hollock* poles in this plantation are from 35 to 50 feet in height, and up to two feet in girth. The slender stems seen in the photograph are *ajhar*. As the camera was facing across the plantation lines the latter do not appear.

One of the objections that may be made to plantations of this kind is that they substitute a crop of a single species for a mixed crop of many species, and thereby change the forest type. This need only be so to a limited extent. The greater portion of the area planted in this way up to date in the Sibsagar Division has been sown with mixed *hollock* and *ajhar* seed, the proportion in any year varying with the relative abundance of the seed of the two species.

The main essential is to get sufficient seed on the ground to ensure a mass of seedlings able at an early age to compete with weeds. Except on a heavy soil *hollock* will take the lead, but the *ajhar* will follow hard after, and when the first thinning is done either species may be favoured. In thinning the 1927 Sola Reserve *taungya* (Plate 30) in 1930 *hollock* was favoured but the *ajhar* which it dominated was not cut out. The result is an under-storey of healthy *ajhar* plants from twelve to twenty feet in height. Before the next thinning is done, the question of the extent to which *ajhar* will be allowed to participate in the final crop will have to be considered.

There are several superior timber species, normally found in association with *hollock*, which if necessary can be introduced under an established *hollock* plantation to increase the variety of the final crop and its resemblance to the more common *hollock* association. *Artocarpus chaplasha*, *Amoora wallichii*, *Cinnamomum cecidodaphne* and many of the *Magnoliaceae* are suitable; and if seeds are dibbled or sown in the inter-lines when the *hollock* canopy has reached a height of twenty feet, any seedlings which result should readily become established. The writer has tried under-planting *hollock* in this way with *Artocarpus chaplasha* and *Mesua ferrea*, with quite promising results. Some of the species mentioned would of course pass right through the *hollock*,

Broadcast Strip *taungya* plantation of *hollock* (*Terminalia myriocarpa*) and *ajhar* (*Lagerstroemia flos-reginae*) five years and three months old. The slender poles are *ajhar*.

but as their proportion in the final crop would be regulated, this would not be of importance. A mixture of this kind, apart from silvicultural considerations, has much to recommend it in that it would produce a crop to meet a variety of requirements.

Now we shall have to deal with another financier man for a moment. We know the information he seeks, and the best I can do is to put some figures before him and leave him to form his own conclusions :— In *taungya* areas there is no expenditure during the first two years when the field crop is on the ground, other than the cost of seed collection which amounts to about a rupee per acre. Sowing is done by forest guards. The thinning in the third cold weather costs from Rs. 2/- to Rs. 4/- per acre. The total expenditure to date (August 1932) on the 1927 *hollock* and *ajhar taungya* plantation of 30 acres in the Sola Reserve (Plate 30) comes to Rs. 90/2/0, or just over Rs. 3/- per acre.

Departmental plantations up to the present have been confined to areas where there is a ready sale for firewood. The most satisfactory method is to sell both timber and firewood standing, and impose a condition that the purchaser should leave the area completely cleared, and the *débris* in a condition for burning by a fixed date, say the 1st March. In the current year's plantation of 30 acres in the Holongapar Reserve the combined operation of burning the *débris*, and clearing and lightly hoeing the lines preparatory to sowing, was given on contract at Rs. 5/- per acre.

The following may be taken as the average expenditure in departmental plantations up to the completion of the first thinning in the third cold weather—that is, to the stage which Plate 29 depicts :

Burning *débris*, and preparing lines for sowing per acre=Rs.	5/-
Sowing (by forest guards)	*nil.*
Seed collection, per acre	1/-
1st weeding, during the first rains, per acre ..	3/-
2nd weeding, during the first rains, per acre ..	3/-
3rd weeding, during the first cold weather (if necessary)	1/8-
Cleaning during the second cold weather, per acre ..	1/8/-
Cleaning and thinning during the third cold weather, per acre.	3/-
Total ..	18/-

Thus, in departmental plantations the total cost up to the completion of the first thinning at the end of the third year is approximately Rs. 18/- per acre; and in *taungya* plantations Rs. 3/- to Rs. 4/- per acre. The financier will argue in connexion with the former that if the purchaser of a firewood coupe is required to fell material which is of no value to him, in order to comply with the condition that the area must be left completely clear-felled and ready for burning, the price which he is prepared to pay for the coupe will be reduced by an amount at least equal to the unremunerative expenditure which he will have to incur; and that in this case Revenue will be called upon to bear a portion of the cost of the plantation. That is exactly the kind of awkward objection our financier *would* make. For the sake of peace I will allow him to debit the plantation with a further Rs. 5/- per acre—but not another bean. It will only be a mental debit in any case. Now we shall leave him to think it over.

There is one other question which must not be left unanswered. What is to be our present policy in relation to our existing reserved forests? At the risk of still further outraging the immortals I venture to advocate the following:

1. Postpone all expensive cultural operations over extensive areas until some evidence is forthcoming from experiments in small areas that such operations are sound, both financially and in relation to our objects of management.

2. Control fellings by a girth limit.

3. Carry out a climber cutting in each compartment a few years before each periodic felling is due.

4. Set aside the best and most accessible areas of our reserves for planting up on the lines I have advocated, and make up our minds to resist to the death all attempts to disforest them.

The chief merit of these recommendations is cheapness. If the girth limit for the different species is carefully chosen, and varied where necessary, there should be no deterioration of the forests. We have little right to expect improvement. Content in the knowledge that we are building up in our new plantations forest wealth adequate to

meet our visible future needs we can afford to be generous when pressure for land arises, and disforestation of extensive blocks of reserved forest is demanded. Sixty years hence the twelve hundred square miles of forest reserves in this Division will undoubtedly have become substantially diminished but if we follow the scheme of planting which I have ventured to advocate, I feel certain that the real wealth contained in twenty square miles, composed of a series of fully stocked even-aged plantations, will far exceed the present value of the entire twelve hundred square miles.

I do not suggest that any kind of finality has been reached in the experiments which have been carried out with such encouraging results. Experiment must continue, with the object of introducing improvements in method and, if possible, reductions in cost ; and also todiscover means of dealing with enemies that may lurk in waiting for a type of forest that to some extent is new.

And now a final word to the immortals. It may be that what I have advocated is not silviculture. Perhaps it is too brutal for that. But we live in a material age which esteems brute strength as highly as the gentlest seduction if it gives the same results and more highly if it gives better results. I do not say it is a better age, but we who live in it must take things as we find them. The Assam evergreen forester of the future will hold his head high, but his charity will spare a *requiescat* for a generation which thought by tenderness and love to make a garden from a wilderness, and reaped but disillusionment and shame.

BURMA FOREST SOILS.

By A. H. M. Barrington.

(As a reminder of the valuable pioneer work done by the late Mr. Barrington we venture to reprint the following short paper which he wrote for the *Journal of Ecology* (Volume XVIII, 1930). In view of Mr Champion's contribution in this number outlining the progress of forest soil research in Europe, we trust that Mr. Barrington's fine example may lead more of our officers to follow where he has shown the way.—Ed.)

I joined the Indian Forest Service (Burma) in 1907, and in 1923 was transferred from a division to become provincial Sylviculturist. The importance of soil and "weed" growth was impressed on me by examination of forest types and measurement of dominant trees over a wide area and by comparing notes with Dr. L. Dudley Stamp, who was then preparing his *Vegetation of Burma* from official sources. I returned from leave in 1926 convinced that a detailed study of soil and vegetation was necessary to avoid mistakes in planting and to understand the distribution and growth of forest trees; and was posted to charge of the Hlaing circle, which contains half the plantations in the province.

For the identification of plants, the forest department already contained efficient machinery. Any specimens which cannot be matched by the Forest Botanist are sent by him to Calcutta or even Kew, and on return are added to the provincial collection. In three years I sent some 400 specimens, many of them imperfect or, to a specialist, painfully obvious, and am much indebted to the patience and courtesy of successive holders of the post, Messrs. C. W. D. Kermode and C. E. Parkinson.

The analysis of soils was not so easy. The agricultural department was, as usual, ready to help, but the agricultural chemist was temporarily doubling his post with charge of the college at Mandalay, and work on my samples would be a whole time job for any of his assistants. In spite of the extra work already forced on him, Mr. J. Charlton generously undertook to supervise and elucidate the analysis of forest soils provided that the forest department would pay for an additional assistant chemist and the necessary material. Government sanction followed, and Mr. B. M. Desai was appointed on trial in May 1927 and has been at work on forest soils ever since.

Any results from this investigation will therefore be the result of team work, and the greatest credit will be due to Mr. Charlton who volunteered for the most difficult task. All that I can claim is an instinct for forest types, a smattering of botany, and (thanks to Mr. Charlton) an increasing interest in soils.

The area concerned is Hlaing forest circle, or roughly Lower Burma between the Irrawaddy and its eastern watershed the Pegu Yoma. The circle extends from 16° 29′ to 19° 45′ North and from 95° 10′ to 96° 25′ East. Rainfall increases from little over 30 inches in the north to 110 inches near Rangoon and the sea, and is very largely concentrated in the five months from mid-May to mid-October. The climax vegetation is everywhere forest, and most of the sample plots were chosen in the 2,000 square miles of forest reserves because vegetation in them has been least subject to human interference.

Altogether 53 sample plots have been chosen, but identification and analysis are complete only for the first 25. The plots are 33, 50 or 66 feet square according to the height of dominant trees. Samples of the soil are taken with an auger as nearly as possible at the centre and four corners of each plot, and those for each horizon (usually 0-3 and 3-12 inches and then every foot) are mixed together to obtain an average. The auger works best when the soil is neither too hard (February to May) nor too wet (June to October), so the most favourable months are November and December. A second visit is rarely possible, and therefore herbs which only flower in the rains are likely to remain unrecorded until and unless a special officer can be spared to devote his whole time to the investigation.

Girths of woody shoots are measured at $4\frac{1}{2}$ feet from the ground, and heights of dominant trees are recorded. A special herbarium has been started, and after 1929 it should be possible to identify most of the common "weeds" without reference to the Forest Botanist.

There is no classification of soils likely to suit our special requirements, but Mr. Charlton's texture index number provides an automatic standard of comparison. Since neither the minimum nor the average diameter of each class of particle is known, calculations are necessarily based on the maximum, and from it the relative surface area for any unit of volume is 0·7920 for clay, 0·1584 for fine silt, 0·0396 for silt, 0·0079 for fine sand, 0·0016 for coarse sand, 0·0005 for fine gravel, and virtually nothing at all for coarse gravel and stones.

To obtain a texture index for any given sample, multiply the percentage of each class of particle in it by the corresponding fraction

and total the results; thus 10 per cent. of clay gives a relative surface area of 7·92, 5 per cent. of fine silt 0·79, 7 per cent. of silt 0·28, 20 per cent. of fine sand 0·16, 25 per cent. of coarse sand 0·04, and 33 per cent. of fine gravel 0·02; giving a texture index number of 9·21 for a sample containing those percentages.

The extreme values obtained among the first 25 sets of samples were 1·09 for a gravel and 12·37 for a calcareous clay.

Texture indices are plotted downwards from a base line representing the surface of the ground. Depth in feet and inches is shown on a scale to the left, and texture indices along the base line at the top. Figures are plotted at the average depth of each sample, usually $1\frac{1}{2}$ in. for 0-3 in., $7\frac{1}{2}$ in. for 3-12 in., $1\frac{1}{2}$ feet for 1-2 feet, and so on. By joining these points one obtains a diagram of the soil profile. In developed soils the finer particles have been washed out of the surface and are concentrated at some depth below it, so that the 0-3 in. horizon is relatively coarse and some deeper layer decidedly stiff, while still lower the texture reverts to normal, roughly an average between the two extremes. A soil-texture diagram shows these changes as an angle pointing to the right, its lower side gradually falling from it to vertical; and the relative acuteness of the angle or "peak" is a measure of its importance. In some cases the change is so marked that the peak limits the effective depth of the soil, any water passing beyond it being drained downwards and out of reach of roots.

Abnormalities are iron pans or conglomerates, lateritic layers where the rainfall exceeds 50 to 60 inches, and new soils still stratified as they were deposited. A few soils have two distinct peaks within 6 ft. of the surface.

Data are still so meagre that the word "probably" should lurk like a ghost in every statement. Rainfall has considerable influence on low growth, but very little on forest types. Evergreen Dipterocarp forest is barely a true climax round Rangoon (110 inches), and still a postclimax 90 miles north with little more than half the rainfall; and dry Dipterocarp forest, notably *Dipterocarpetum tuberculati* or *indaing*, flourishes on sandy soils whether the rainfall is 30 or 200 inches.

Apart from lime, which is most important, neither chemical composition nor acidity seems to exercise any marked effect on the distribution of trees. Even the selective influence of lime is at least partly due to its power of lightening the soil. Not only are clay particles deprived of their (colloidal) cohesion but they are grouped into complex aggregates and allow the passage of water as if they were the larger units of silt.

Teak (*Tectona grandis*) forms some 12 per cent. of the tree crop in forest reserves, but the volume exploited is equal to, and roughly four times as valuable as, that of all other species combined. The most important result of this enquiry will therefore be its practical application to the sylviculture of teak. As a broad generalisation, dominant teak requires a surface texture index of not less than 3 (say 60 per cent. gravel and sand and $2\frac{1}{2}$ per cent. of clay), and peters out if any superficial layer exceeds 20 (say 18 per cent. clay) unless there is at least 1 per cent. of lime in the soil. For strongly calcareous soils the upper limit, if it exists, is much higher.

The recognised classes of teak average at maturity 145 feet high for class Ia, 125 feet for class I, 105 feet for class II, and 85 feet for class III. For any unit of area, first class teak produces about double the volume and four times the value of third class teak, and it usually costs less to establish. The rate of growth in plantations is therefore of considerable importance, and any means of recognising first class soils would be welcome.

Class Ia is exceptional and probably confined to alluvium. The first sample taken had a texture index of 13 for the top 3 inches and round about 8 lower down ; it is alluvium in course of formation and well supplied with water. The second plot is on old alluvium, a slight rise in the rice fields with excellent local drainage ; it stiffens from a little over 11 on the surface to rather over 20 in the 1-2 feet horizon, remains there down to 5 feet, and falls back to 15 at 5-6 feet. In both cases the teak has been planted, but it probably occurred in the original crop.

At the other extreme, third class teak in mixed forest is replacing much larger *in*, or *Dipterocarpus tuberculatus*, on a soil which zigzags from rather over 8 at the surface to over 20 at 2-3 feet, back to 6 at 3-4 feet, and to nearly 16 at 5-6 feet. Whatever may be the positive requirements of a first class soil, absence of sharp peaks is certainly a negative one.

The flocculation of minute clay particles into complex aggregates is a known but unmeasureable quality of lime. Unfortunately the treatment necessary to analyse soils is so severe that all these complex floccules are disintegrated, and calcareous soils appear on analysis to be as stiff as their ultimate components. A soil with a texture index of 27 and 1 per cent. of lime at 1-2 feet is too stiff for teak, yet one with an index of 42 and 10 per cent. of lime on the same horizon is not. It is said that 2 or 3 per cent. of lime are as efficient chemically as 25 per cent., and a third soil with only 2 per cent. of lime and an index of 31 produces first class teak. The only possible bridges between calcareous and non-calcareous soils seem to be indirect, such as the permeability tests now started.

Teak covers so wide a range of soil and rainfall that indicators are necessarily complex. *Kyathaung* (*Bambusa polymorpha*) undergrowth over 70 feet in height is always safe; it only grows on medium soils with good drainage and water supply. In the family *Acanthaceæ*, *Justicia decussata*, *Strobilanthes imbricatus* and *S. phyllostachyus* are useful where the rainfall does not exceed 90 inches. On stiff soils, well-grown *hmyinwa* (*Dendrocalamus strictus*) undergrowth is a good indication provided that the soil is neither whitish, grey, nor blue; calcareous soils are usually red, yellow or brown in this circle.

Second in importance to teak, and about equally common, is *pyinkado* (*Xylia dolabriformis*). It also grows best with *kyathaung* (*Bambusa polymorpha*) undergrowth, and often with *Justicia decussata*. It is never found on heavy soils, whether calcareous or not, and has a rather more restricted range of dominance than teak, probably a texture range of 6-15 as against 3-20. On the other hand, *pyinkado* grows rather larger than teak and endures far more shade,

so that under "natural" conditions it has considerable advantages over its rival. The smashing of bamboos, inseparable from extraction by elephants, and fire, particularly the bonfire of a temporary clearing, favour teak, while an unbroken canopy and protection from fire encourage *pyinkado*: and the balance is so even that the slightest advantage to either may lead to local elimination of the other.

The investigation has been least incomplete in respect of coarse soils, *indaing* (*Dipterocarpetum tuberculati*) is a park-like association with a single dominant. It reigns supreme over dry soils with a percentage of coarse sand and gravel in excess of 75. With more available water, the same soils would probably grow evergreen Dipterocarp forest, and a slight stiffening of the soil entirely alters the association. Observation and nursery experiments show that the surface horizon is most important. Three inches of finer soil over coarse sand prevent the reproduction of *in*, and conversely 3 inches of coarse sand over an ordinary soil may lead to established *indaing*. Within comparatively wide limits, the consistency of the soil below the first 3 inches is unimportant, but any sharp peak in the texture index limits the height of the trees. Thus a new alluvial sand produces *in* up to 125 feet high, but a peak or pan at 1½ feet limits growth to 50 feet. A typical old *indaing* soil has a texture index of less than 2 down to 3½ feet and then stiffens out to 12: it is in fact a podsol.

Indaing indicators in the north of the circle are *Cephalostigma paniculata* (*Campanulaceæ*), *Aniscmeles candicans* (*Labiatæ*), *Hibiscus abelmoschus* (*Malvaceæ*), *Cycas siamensis*, and the grasses *Andropogon fastigiatus*, *Aristida adscenscionis*, and *Eragrostis tenella*.

Soils almost as light, but with fine substituted for coarse sand, produce *Pentacmetum suavis*, a very similar association but a change in the dominant species. These again are very closely related to inferior teak soils, and, with more available water, would probably grow postclimax evergreen Dipterocarp forest. Just as *in* can grow on a variety of soils once the seeding is established, *ingyin* (*Pentacme suavis*) occurs on very stiff soils, and its absence between texture indices 8-20 is probably due to intense competition rather than choice.

The third of the dry Dipterocarp species, *thitya* or *Shorea obtusa* seems to be confined to soils intermediate between *indaing* and mixed forest with teak. If the percentage of coarse particles at the surface falls below 75, teak or *thitya* becomes dominant, but teak prefers at least 5 per cent. of clay. Teak of about second class has been found with *thitya* over 140 feet high.

The last of the coarse soil types is a complex association on Rangoon laterite. The texture index number is about 5 on the surface, stiffens fairly uniformly to 15 or so at 2-3 feet, and turns to true laterite at 2½-5 feet. The dominants in this association are *Dolichandrone stipulata* (*Bignoniaceæ*), *Holarrhena antidysenterica* (*Apocynaceæ*), *Grewia microcos* (*Tiliaceæ*) and in the low growth *Calamus viminalis* (*Palmæ*). Trees are seldom more than 80 feet high, but teak and *pyinkado* in plantations have grown well enough to justify artificial regeneration so near large markets; neither occurs in the association, though each forms pure groups on patches of rather similar soil in the neighbourhood.

The competition on medium soils, say the range of texture indices 6-20 at 3-12 inches, is so great that only the more important species can be disentangled without years of study. The first 53 plots were selected mainly to understand the distribution of teak, but they should also elucidate the requirements of *pyinkado*, *in*, *ingyin*, *taukkyan* (*Terminalia tomentosa*), and *cutch* (*Acacia catechu*).

On stiff calcareous soils the only constant species are *cutch*, *Albizzia procera et odoratissima*, and the almost ubiquitous "weed" *Barleria strigosa* (*Acanthaceæ*). *Taukkyan* occurs on three out of four plots, and teak on two.

General, but necessarily tentative, conclusions are as follows :—

(*a*) There is, at present, no standard of comparison for calcareous soils.

(*b*) Mr. Charlton's texture index number provides a scale for soils with less than 1 per cent. of lime ($CaCO_3$).

(*c*) The superficial horizons determine species, and "peaks" in the soil profile limit height growth.

(*d*) No species should be planted far outside its range of dominance on Mr. Charlton's scale.

(*e*) But species which are dominant on both sides of any range are probably only excluded from it by competition and should therefore thrive if planted within that range.

It is only fair to Mr. Charlton to add that he considers the average texture index down to 4 or 5 feet more likely to determine tree species than the first 12 or 18 inch. I may be too much influenced by the special case of *in*, but so far I disagree.

SHIKAR NOTES FROM SOUTH INDIA.

BY RANDOLPH C. MORRIS, F.Z.S.

Destruction of Game in South India.

A Forest Officer recently told me that he was appalled at the complete absence of deer in the forests he knew not very many years back to hold large numbers. What has happened, and is still going on, in his division is no isolated instance. The same is occurring in many other districts of the Madras Presidency, and the sooner the gravity of the situation is realised by Government and strong action taken the more chance there will be of preventing the complete extermination of deer throughout those districts.

Other issues are involved. Ganjam is an example of the results of the destruction of the natural prey of the Carnivora—nearly every tiger is a man-eater. A tiger will *not* only turn to cattle if his natural food (game) is no longer available: experience has shown that he will leave for other areas where game still exists—cattle or no cattle. But what if the game is exterminated in those localities too? Is it not possible or rather likely that what has occurred in Ganjam may occur elsewhere?

And then the wild dogs: they have of recent years taken to attacking grazing cattle increasingly: and they are naturally preying on the deer in areas which still hold deer to a far greater extent than before, and this cannot go on for ever. Will nature step in, and

through disease, lessen the numbers of wild dogs, or will they, from sheer hunger, become a perfect terror to cattle, and possibly mankind ?

Poaching is not confined to guns, netting is being increasingly resorted to. Things have now come to such a pass that only strong measures will prevail such as—

(1) a house-to-house search for illicit guns in villages close to Forest Reserves, supervised by an A. S. P. ;

(2) the stricter enforcement of the Laws against poaching and netting and the infliction of deterrent sentences on offenders ;

(3) the issue of only short barrelled guns for crop protection; and

(4) a Law to prevent the marketing of horns, hides and flesh of game.

Considerable opposition is to be expected to the two last, but I believe that with a certain amount of propaganda, Ganjam being held an example that is likely to be repeated elsewhere if the game is exterminated, this will be overcome. Poaching is a lucrative business, as a full-grown sambhur is said to be worth about Rs. 30/- to the poacher, and a chital Rs. 15/-. Is it any wonder that, with guns of all descriptions available for the poacher, both illicit and license (a good many of the ryots are not above lending or hiring out their guns) his name is legion.

Longevity of Tigers.

Mr. A. F. Minchin's interesting note on the longevity of a man-eater in Ganjam is, I think, equalled by the history of the Bargur man-eater (Kollegal and North Coimbatore Forest Divisions) which was the periodic scare of the Ramapuram-Bargur ranges for 15 or 16 years. This tiger apparently varied its diet with men, cattle and game killing, rather a peculiar case. It was finally shot in 1928 by a poacher, who was out for a stalk in the early morning, met the tiger round a corner, fired, threw down his gun and bolted for dear life. The tiger was later in the day found lying dead. Needless to

say, the man did not claim the reward knowing he would be prosecuted under the Arms Act and for poaching. This tiger must have been quite 20 years old at the time of its death.

Solitary Bull Bisons.

Is the generally accepted belief that solitary bulls become so after being driven out of a herd by younger herd bulls correct? Personally I do not think that this is always the case, and my opinion is that in many cases a bull comes to an age when he leaves the herd voluntarily, preferring to live a solitary life. These solitary bulls will generally attach themselves to a herd at some time during the breeding season, and I once saw a pair of magnificent old bulls fighting with two obviously herd bulls, and they seemed to have no difficulty in defeating their opponents. One has only to see a fine solitary to realise the strength contained in its huge proportions, and to my mind it is inconceivable that such a bull will allow itself to be defeated by a younger herd bull which, though perhaps more active, does not compare in strength and size with its elder.

It would be interesting to know the average life of a bull bison and whether the corrugations on its horns have any relation to its age. A very old bull recently shot in these parts with one horn worn to a stump had nine corrugations on the other horn which was also very worn. This old bull was deaf, partly blind, and had lost most of its teeth. Another head of a very old bull has been picked up in the Tinnevelly District with no less than 31 corrugations in a depth of 15 inches. I should think that it is quite possible that both these bulls were between 20—25 years of age at the time of their death.

Control of Deer and Bison.

An enquiry recently went round, and I believe is still continuing, as to the best methods of controlling deer in Game Sanctuaries in India, regulating their numbers and the correct proportion of hinds to stags. One of the replies received suggested, among other points, that herds should be frequently moved about from one grazing ground to another, putting down rock salt, the shooting off of stags that are past their prime and of superfluous hinds; and, in connection with bison, the

breaking up and moving of herds to different grazing grounds. These are probably the methods of perfection, but without a properly controlled and efficient Game Department in charge of the Sanctuaries I doubt whether they are workable in Sanctuaries in India.

I share the opinion of Mr. R. D. Richmond, I. F. S., who is keenly interested in the subject of Game Preservation, that for the present the problems of over-stocking (if such a problem exists) can be best dealt with by allowing or asking license-holders to shoot stags that are past their prime and old hinds, where the proportion seems to be more than say eight hinds to one stag in its prime. Mr. Richmond has also advanced the opinion that the size limit in deer should be abolished, and in this I fully concur as the stock must deteriorate if only the best stags are shot.

In the case of bison it is essential I consider to prohibit the grazing of cattle in Sanctuaries to prevent a recurrence of such a disaster as occurred in the North Coimbatore and Kollegal Divisions in 1919, when about 50 per cent. of the bison died from rinderpest. In this connection I should like to add that I have never come across a case of a tiger or panther feeding on the carcases of rinderpest victims, cattle or bison, and I am informed by the locals that this is always the case. It would be interesting to hear the experience of others on this point.

Sense of Smell in Humans.

Why has the average jungle man of South India, he be Sholaga, Kurumba or any other jungle tribe, such a poor sense of smell? In the plainsman, and in the European unacquainted with the jungles and shikar, this atrophied sense of smell is to be expected, but this is a surprising feature also of the jungle tribes. I nearly always smell elephant, bison or sambhur long before my Sholaga trackers do, if they do at all. Strangely I have found that some women can generally smell the presence, or recent presence, of a tiger or panther quicker and better than I can and a good lady closely related to me once asked whether I could explain this. My reply that I could give no reason unless it was a case of one cat smelling another easily drew the cold retort that she was not amused! However it *is* an interesting point.

EUROPEAN SYLVICULTURAL RESEARCH AND ITS BEARING ON INDIAN PROBLEMS.

By H. G. Champion, I.F.S.

In the following series of short articles, I propose to consider in relation to Indian experience and problems some of the notes collected during the course of two tours made on study leave in 1931. These tours, one in Central Europe, and the other in Great Britain, were made with the express object of finding out what India could learn with regard to research methods for application to her own problems, whilst considerable value was attached to making personal contact with the research staffs and discussing matters with them. A report was submitted in the usual way, but will not be printed and only a few copies have been circulated in type-script to those most immediately concerned.

The following subjects will be dealt with in turn :—

(1). Soil problems.
(2). Root competition, etc.
(3). Inheritance problems.
(4). Mixtures.
(5). Sylvicultural systems and natural regeneration.
(6). Artificial regeneration.
(7). Thinning investigations and pruning.
(8). Crop increment sample plots.
(9). Use of statistical methods.

1.—Soil Problems.

In India, we have little cause to be proud of the extent of our studies into forest soils, though we are fond of doing lip service to the importance of the matter. We have a certain amount of empirical information on the temperate climate soils supporting the hill coniferous forests and the saline soils of the irrigated Punjab plains, and scattered observations from various parts of India, but the only systematic pieces of work known to the writer, are that on the teak soils of Burma by Mr. Barrington, and that on sal soils at Dehra Dun by Dr. Sen.

There are reasons which if not altogether exonerating us from blame, at least provide us with some excuse for our apparent lack of interest or application, the chief of which is the lack of experienced soil scientists and the appropriate laboratory facilities. Admitted that the Agricultural Department has fully qualified experts, they have also such an enormous field to deal with already and the prospects of immediate utilisation of any discoveries made are so much greater in agriculture than in forestry, that special interest in forest soils is not to be expected. The uninitiated, incidentally, are rarely aware of the amount of labour involved in soil analyses, particularly chemical analyses, and how little of it can be done by an ordinary laboratory assistant. We know of several instances where help would have been given, but for the unrealised largeness of the request made.

At the Forest Research Institute we have had a Chemical Branch for many years, and although the officer in charge can largely cut out purely inorganic chemistry from his field of activities, he is expected to deal with all the many problems connected with wood preservatives, the paper pulp industry, and the legion minor forest products, as well as find time to deal with any soil problems that may be sent in. This is asking the impossible, and we must expect actually or at least relatively to stagnate till we have a specialist on soil science, as have practically all the continental forest research institutes—it is a matter for regret that the Imperial Forestry Institute in England has lost theirs as a retrenchment measure, but at least they are in a position to consult the famous Rothampstead Experimental Station or the School of Rural Economy at Oxford, with the certainty of getting fully qualified opinion on problems that crop up.

Laboratory facilities naturally vary a good deal at different institutes, but the new Cottabau added to Saxony's equipment at Tharandt is worthy of mention as the last word in this direction, being expressly designed and built to facilitate all stages of the study of soils from the receipt of the samples in bulk and their storage till they can be dealt with, to the finest observations required on them. Dr. Krauss is in charge of the work at Tharandt and has recently published a map classifying the whole of Saxony into climate and soil types. This is

an example of the heavy spade work necessary even in so well developed a country as Saxony, to provide a proper basis on which to build. The view is rightly taken that intensive study should in the first place be concentrated on, and in fact limited to soils carefully selected as representative of the really important types. To determine what those types are, and to assess their relative extent and importance, is a most essential preliminary in any well conceived programme. It is commonplace knowledge that few things are easier than to collect data about soils, and few things more difficult than to derive conclusions from them suitable for practical application. It was pointed out, perhaps with meaning, that such a soil survey should precede vegetation surveys.

Humus problems are receiving a good deal of attention as is natural in temperate forests. Tharandt is particularly engaged on humus studies and the routine use of photography for recording soil profiles is a noteworthy feature.

Soil acidity, being perhaps the easiest single factor to determine, always invites attempts to correlate it with growth potentialities. Field methods for determination of pH are in favour, particularly the colorimetric methods with comparison against liquid or dry standard tints. The limitations of colorimetric methods are generally realised, but it is felt that provided these limitations are borne in mind, the great simplicity of the determinations outweighs the disadvantages. A particularly interesting and instructive example of the relation of forest crop to soil acidity was seen at Münden. A certain soil type carried a mature 180-year-old beech crop of Quality III-IV at the upper limit of distribution for the species. The soil was highly acid (107 units) and natural regeneration was entirely wanting, so it was felled and regenerated artificially with oak, spruce and larch. After a few years, the acidity had fallen to 36 units where the oak had been planted, but had again risen with the spruce even to 131 units, the larch plantation showing an intermediate value.

At Münden also, promising investigations are in progress dealing with the connection between soil and weather, and natural regeneration of beech. These are of special interest from the point of view of

method and for the intimate relation between research and practice. The line of attack is primarily analytical, being a critical examination of the conditions under which regeneration succeeds or fails, with chemical, physical and biological analysis of the soils in question, checked by the behaviour of beech seedlings grown in samples of the same soils, under controlled conditions in the glass house. Here we have an illustration of the time saving value of a suitably equipped experimental laboratory where any required set of conditions can be studied, undisturbed to a large degree by weather and seed year vagaries. Success in regeneration is traced in this instance to the rate of decomposition of the humus which is most favourable with 3-yearly periodic openings of the overwood.

Recognition of the importance of the physical properties of the soil as generally surpassing that of the chemical properties and as on the whole simpler of interpretation and understanding, is gaining ground—though the line between chemical and physical is now so finely drawn as to be barely distinguishable. Physical properties also have the advantage of simpler and quicker determination than the chemical, even though in many respects they lack the wonderful appearance of precision of a chemical analysis.

The most obvious physical property is the percentage of soil particles of the accepted standard size grades— ignoring the fact that so significant a part is played by the big range included in the finest grade. This percentage composition obviously requires study with regard to the depth of the sample under consideration, for this largely determines the distribution of moisture and inorganic food in relation to the feeding roots of regeneration or established crops. Such a study was in progress at Eberswalde (Prussia) in an attempt based on some 300 sample plots, to correlate soil type and such factors as fine silt content at 50-70 cms. depth, and depth of lime leaching, with quality class ;—a publication on the subject is looked for.

Another illuminating investigation recently completed is that by Dr. Burger on the effect of tree crops on the porosity of the soil in Switzerland, particularly on the changes brought about by afforesting grass land. It is a significant discovery that even after 50 years,

pure spruce has exerted very little influence on this factor, except in the topmost layers, whereas broad-leaved species are much more active and far-reaching in their effects. It may be mentioned that we have similar investigations in progress at New Forest but so far they are only six years old. The application to practice is obvious, for with many types of soil, productive capacity is correlated with porosity.

The neighbourhood of the Prussian Forest Research Institute at Eberswalde is geologically, topographically and pedologically of special interest as having been determined by the advances and retrogressions of the great Pleistocene ice sheets with their glacial lakes, streams, moraines, etc. The surface soil is very largely sterile sand and so Scots pine is the dominant species, but beech is plentiful on the old moraine slopes. Some 15 years ago systematic attempts were made to get up a new crop of pine under a light cover, either from natural regeneration or sowings, and to perpetuate the beech-pine mixture. About 200 plots were tried and only a very few have succeeded. These experiments must have suggested the detailed investigation described to me on the spot by Dr. Wittich. Soil pits were dug and profiles recorded in a large number of selected spots, and moisture contents measured as the factor evidently of chief importance. It was found that the limiting factor is the depth of porous sand overlying a moisture-retaining loam, all the successful plots having only a few feet of sand, or else (in a few instances seen) obviously extraneous supplies of water. The correlation between quality class as reflected in crop height and the thickness of this sand layer, was also found to be very close, and prediction could be substantiated by observation in many cases. Once again the information collected has an immediate practical value for predicting the result of planting up these apparently uniform sandy tracks.

The answers given to a question put to most of the soil experts met would lead to the conclusion that they have yet to give due consideration not only to the accuracy of their determination of any given constituent or property of a sample, but the accuracy with which the sample represents the real average of the soil from which it is taken.

Statistical methods appear greatly needed but very generally neglected in this field.

I was curious to learn the attitude of continental foresters to manuring as a practical proposition (outside nurseries of course) and so was interested to find that at Eberswalde an investigation is in progress on the cost of and response to liming over-acid soils in beech regeneration areas, and that a set of plots has been laid out in spruce plantations at four different altitudes to determine the minimum phosphate content necessary to enable productive capacity to reach Quality Class II. The latter work was undertaken as a logical development of some work carried out in another part of Prussia, under different conditions by Hackmann. The general attitude appeared to be that whilst manuring was not very likely to prove a practical proposition, foresters ought to know what response is made before reaching a decision.

Peat lands were not visited on the continent, at least not where any planting work was in progress, and it is to peat soils one must go to hear the praises of artificial manuring sung. Afforestation of such soil forms an important item on the British Forestry Commission programme and the result of the stimulus to growth of a dosage of basic slag is one of the most striking phenomena I have seen— it almost looks pathological. A common dose is two ounces per plant and the effect is mainly shewn in the second season and to a less extent in the third. The cost is about five shillings an acre with the cost of the slag at £5 per ton delivered in the forest. Experiments are obviously called for as to the value of further applications, and the effect of applying the standard dose in two or more applications and so on, and such experiments are in fact in progress. No other chemical manure has produced such great effects. It has yet to be seen whether the benefit will remain to be reaped at maturity or whether in the long run development will fall off, with the result that though one may have succeeded in raising a crop where without the manure it could not have been raised or only raised in a much longer time and poorer stocking, it will still be so poor a crop as to give no economic return.

It has also been pointed out that the exceptionally wide annual rings laid down under the stimulus of the slag will degrade the timber significantly.

Phosphatic manure on peaty soils is known to promote mycorrhiza formation and general development, but cause and effect have yet to be distinguished. Experiments have been made inoculating with soil which should contain the appropriate mycorrhiza organism, but results are so far inconclusive though significant improvement has been obtained in some instances. Other mycorrhiza studies are in progress supporting the general trend of belief that these associations play a larger part in tree development than has hitherto been recognised.

Naturally, a good deal of attention has also been given to drainage problems on peaty soils, but this is not of much importance to us in India and so will not be discussed.

Green manuring in permanent nurseries is now almost a routine measure in Britain and on the continent. Yellow lupin seems to be the best and is ploughed in just as it comes into flower, requiring to be cut first if exceptionally vigorous ; this was seen at Oxford, Inchnacardoch, Eberswalde, etc. Little in the way of special experiment to compare the value of green manuring with other forms was seen except at Biesental (Eberswalde) where comparative studies were in progress with lupins, phosphatic manures, humonit, etc. At Freiburg, a well devised experiment was seen for testing the value of phosphates with nursery stock of three species, but as often happens in such experiments, the soil was apparently already well enough supplied and virtually no response occurred.

In the course of the tours, opinions were collected on the practical value of Cajander's theory of Forest Types, and it was discussed with numerous research workers. Views have been published from most countries of course, but many of them have been founded on very limited data in comparison with Cajander's and not a few on general impressions rather than proof. The general attitude appears to be that whatever its merits in more or less virgin coniferous forests, the underlying generalisations are so greatly obscured by human interference with species and form of tree crop, that for most of Europe,

the theory must remain of more academic than practical value. In view of his wide experience with the Prussian sample plots, a large number of them in the relatively simple forests of the North German plain, Dr. Wiedemann is in a better position than most to form an opinion and he is inclined to support Cajander, though finding it necessary to restrict application to comparable climatic conditions and certain classes of soil—a rather serious restriction. In Britain the special need has been for indicators of soil potentialities, indicators other than tree crops which are generally absent from the areas to be afforested.

It remains to make a few remarks on a rather delicate question which is however important enough to require discussion, *i.e.*, What relationship between the trained and experienced forester and the soil scientist is the most productive of practical benefit to forestry? From the forestry point of view, the soil scientist is an expert in an applied science, and it would seem logical that when the need is felt, he should be called in and asked to solve the problem; in other words, the forester should direct. From the soil science view-point, forestry is a medley of applied sciences and should merely apply the information made available by soil investigations developing along their own lines; in other words the soil scientist should lead, and the forester glean what he can. Finally, there is the view that the two are comparable branches of science and should collaborate on equal terms.

It was found that in different places all these views are represented and translated into practice. Thus one forest research director held that it was much more productive of practical results to have assistants trained in pedology, than an independent pedologist. At another centre, close collaboration between a forester and a pedologist without forestry training has proved and is proving an excellent arrangement. The British Imperial Forestry Institute has no soil scientist, and so it must rely entirely on the independent expert. It is more than probable that the best arrangement depends on the individuals concerned. It may be noted that there is a special post for soil science at Eberswalde, Münden, Tharandt, Münich and Mariabrunn.

Consideration of the preceding paragraphs should lead to the conclusion that soil studies have obtained recognition at most forestry research and educational centres as meriting the whole time employment of a specialist, whether a trained forester or not, and that they have already made important contributions to our knowledge of the factors underlying the development of trees and crops. We may also conclude that there is an important future for forestry soil work in many directions and hope to see a real start made as soon as the present economic depression has passed over. Almost all our above-ground treatment and tending of our forests reacts on them *viâ* the soil, and it behoves us to learn as much about happenings hidden from view in the soil and the soil itself, as we already do about the above-ground parts and their relationship to the atmosphere in which they grow.

STUDY OF SPECTRUM IN THE CHOICE OF SPECIES FOR UNDERPLANTING.

By N. Trimurti, I.F.S.

The choice of species which will grow under the shade of a given species like teak is always a problem of great interest, just as is the choice of species for mixtures. Our present methods are mostly methods of trial and error. The two primary factors which decide whether any two species will grow together, or whether they will be mutually intolerant, are their mutual effects on the soil conditions, and light demands. Of the former it is not proposed to discuss in this note, but the latter will be examined.

The colour of a substance roughly indicates the light waves which it absorbs and which it rejects. As is well known the sun's rays consist of light waves of various wave-lengths and the plants require and absorb only rays of selected specific wave-lengths. It is in practice noted that the leaves of various plants are not all of the same colour and so it follows the wave-lengths of the rays absorbed are presumably different, and the quantities of various wave lengths absorbed might also be different. Otherwise the colours cannot differ.

It is possible by photographing the spectrum of the light filtered by leaf lamina or leaf extracts of various densities of various species, to get graphic representations of the quantities and qualities of the light-waves required by each species for its photo-synthetic metabolism. The results of such study could be indicated by graphs in which wave-lengths are plotted against the thickness of a column of leaf extract of each species examined. Assuming we get some such curves the following inferences could be drawn :

1. Plant No. 2 requires light waves of nearly the same wave-lengths and in similar ratios as plant No. 1, and No. 1 can tolerate more of shade than No. 2. But No. 1 will not survive under No. 2 as the same wave-lengths are required by both and in similar ratios.

2. Plants Nos. 1 and 2 are complimentary to some extent in their light requirements to plant No. 3. Hence they can grow with or under No. 3.

It is quite likely that investigations on the above lines will give us valuable results, and as such I would suggest that such absorption curves should be examined for a series of plants by those who have facilities for spectroscopic work.

Editor's Note on Mr. Trimurties article :—

There is no doubt that results of value might be obtained if this suggestion were followed up, not only in elucidating the choice of species for underplanting teak, but also in other Indian problems such as fir and spruce regeneration in the high Himalayan forests, and in the *Dipterocarpus* plantation work in Southern Bengal. A considerable amount of intensive research has been done in Europe, and in fact the need for exact data on the specific light requirements of forest trees has been felt ever since forestry became a scientific study. A very good summary of knowledge up to date is contained in Büsgen's *Structure and Life of Forest Trees*, which quotes many references to continental forest literature.

The faculty of leaves moving into the best position as regards light was discussed by Oltmanns in 1892. The first detailed spectroscopic study was by Zederbaur who showed in 1906 that the absorption

powers differed considerably between species, the light-demanding pine, larch and birch absorbing less red, blue and violet rays than the shade-bearing spruce, fir and beech. He also showed the inadequacy of measuring only chemically active light by means of silver chloride paper, a method which previous workers such as Wiesner had used, thus failing to deal with the red light which is most freely absorbed by plants. In 1919 G. Fischer showed that in the spectrum absorbed by chlorophyll there are absorption bands whose distinctness and breadth increases with the thickness of the chlorophyll layer penetrated and the strength of the light, but that the efficiency of the different coloured rays was not the same in all phenomena of nutrition.

Anyone who has done forest photography realises that exposures under a leaf canopy have to be very much longer than in the open, some exposure meters giving the exposure for the interior of fairly open woods to be as much as 200 times the exposure necessary for bright landscapes, and the amount for dense tropical woods must of course be even more. For actual measurements early workers used either light-sensitive photographic paper or some form of box scale in which different coloured glasses could be used interchangeably. In 1911 Ramann used selenium cells whose electric resistence alters with illumination, the differences of potential being read off a galvanometer; unfortunately these selenium cells are not constant in their sensitiveness. More recently Rickert in 1926 employed an apparatus based on the illumination of an oil spot on paper, but possibly the most exact results have been obtained by the Swiss, H. Knuckel, who used a rather elaborate and expensive type of spectrophotometer made by Hans Heele of Berlin and described in detail in the Swiss F. R. I.'s publication, *Mitteilungen*, Vol. XI, Part 1 of 1914. With this he proved that the intensity of diffused light decreases rapidly with increasing altitude, and as direct radiation also increases with height, the total light is much more intense at high elevations, and the position with regard to the direction of the sun's rays at high elevations is therefore important in forest work. This is already clearly realised in our deodar work.

There is also an interesting paper by W. R. G. Atkins in the new number of the *Empire Forestry Journal* (Vol. II, Part I, 1932) in which he describes a useful portable photo-electric equipment with which he has obtained useful data of the quality and quantity of light within various types of woodland stated as a percentage of the diffuse daylight, which is measured at the same time outside the wood. His results show that the light in woods is very poor in blue, richer in green, close to sunlight in its content of orange red and much richer than sunlight in deep red, presumably owing to the transparency of chlorophyll for deep red.

REVIEWS.

ANNUAL ADMINISTRATION REPORT OF THE BOMBAY PRESIDENCY INCLUDING SIND FOR THE YEAR 1930-31.

In spite of the civil disobedience campaign which was directed perhaps with more vigour against the Forest Department in the Bombay Presidency than in any other province, a great deal of good work was got through.

Good progress was maintained in the preparation of working plans. Out of 557 square miles for which plans were still required, plans for 265 square miles were under preparation, while old plans were under revision for an area aggregating 1,084 square miles. Three plans were sanctioned by Government during the year.

In general the progress of regeneration is reported to be satisfactory. It appears that, on the whole, reproduction from seed is not to be relied upon owing to the severity of the various adverse factors, such as unrestricted grazing, heavy weeds and grass, steep slopes and unfavourable climatic and soil conditions which the crops have to contend with from place to place. Artificial regeneration is largely resorted to and from all accounts has met with success.

In the Northern Circle teak was sown pure or with other species on burnt patches, failures being replaced by transplants or root and shoot cuttings. In Kolaba artificial regeneration combined with field crops gave excellent results with the following species :— teak, bamboo, *simul* (*Bombax malabaricum*), *Gmelina arborea*, *khair* (*Acacia catechu*), *Terminalia chebula* and *T. tomentosa*. In the Sind Circle 18,559 acres of exploited coupes, *kachas* and blanks were sown up with *babul* (*Acacia arabica*), *Prosopis spicigera* and *Zizyphys jujuba*. In the Hyderabad

Division with a view to affording protection against frost, *babul* was sown under branch wood stacked in lines 45 feet apart, instead of burning all the "slash" as usual. The results were quite satisfactory; at first the seedlings were inclined to grow crooked, but they soon straightened up. So successful has "stump" planting of teak proved that it is considered that this method of propagation is likely to be adopted universally.

As a means of protection from fire the experiment of clearing 5′ lines round each patch in old regeneration areas has resulted in the saving of much artificial reproduction and the method is considered worthy of extension. Efforts are being made to open up a market for teak sawn wood in South Africa. Small consignments have been ordered by one or two firms and although the possibilities of developing real business are uncertain, yet it is believed that some market exists in South Africa for timber of Kanara quality.

An important advance in afforestation work is marked by the receipt of orders from Government for taking preliminary steps with a view to the formation of irrigated plantations in Sind. During the year the Conservator of Forests, Sind Circle, with another forest officer paid a visit to the more important irrigated plantations in the Punjab to study the various problems connected with the formation and management of these plantations and the Conservator reports that from the experience gained by the visit he believes that, given adequate irrigation facilities, irrigated fuel plantations in Sind are not only possible but are likely to prove exceedingly profitable.

An arrangement has already been arrived at with the Public Works Department under which about 10,000 acres of land in the Larkana Division will be gradually brought under irrigation and brought under tree growth. A supply of water amounting to a delta of 3′-6″ per annum during the *kharif* season from the Barrage Canals has been assured, the distributary channels are to be laid out at an approximate cost of Rs. 2 8 - per acre and the full water supply for 10,000 acres will be worked up to gradually with five annually increasing instalments at a cost of Rs. 3,- per acre. Field crops are to be cultivat-

ed during the preliminary five-year period with the object of obtaining revenue and preparing the soil for tree growth.

The surplus for the year was Rs. 9·78 lakhs as compared with Rs. 36·63 lakhs of the previous year; the fall in revenue is attributed to general trade depression, aggravated by the insensate campaign of boycott and picketing organised by the Congress. This is now over and there are already signs of improvement, but evil as the results have been this will always be remembered as a time when all ranks behaved throughout with commendable loyalty and tact under conditions which were always most difficult and at times dangerous.

A. P. F. H.

FOREST TREES AND TIMBERS OF THE BRITISH EMPIRE.

PART I.—SOME EAST AFRICAN CONIFERAE AND LEGUMINOSAE.

This is the first of a series of publications which it is proposed to issue from the Imperial Forestry Institute and after seeing it we await further issues with interest. Although it deals entirely with African species it has an interest which extends beyond the African continent. For example of the 15 species mentioned under 10 sections in the table of contents 8 have been tried in the Arboretum at the Forest Research Institute, Dehra Dun.

This work should prove stimulating to forest officers in Africa mainly in showing how much remains to be ascertained about their trees. For example under *Widdringtonia* a key is given to 7 species which are admitted in the genus. The first is a well known timber tree but it is doubtful whether two species are not included or whether there is a form which does not reach tree size. The second species is doubtful so are the 4th, 5th and 7th. In fact the whole genus requires overhauling not in the herbarium but in the field. It should be possible to collect the South African species together in an arboretum and study them side by side.

Under *Pterocarpus angolensis* a paragraph called " Regeneration " consists of 5 lines. This apparently is all that is on record regarding

the sylviculture of a tree which is common and conspicuous over large tracts of country. There is much one would like to know about this species. The pods are large and bulky and unpleasant to handle owing to the sharp bristles on the central thickened portion. Being a savannah tree it often if not usually occurs on burn areas. In such places the pods are easy to find and collect and are much less bulky as the wings and bristles get burnt. Does the fire injure the seed and is there any objection to collecting burnt pods? Similarly for most of the species there is little or no useful information available.

There are several improvements which we hope will be made in the next part. Firstly it would be much better even at the cost of a little more paper to divide the matter up instead of running on from *Coniferae* to *Leguminosae* on one page. As the series grows many people will probably like to cut up the parts and rearrange them to suit their own convenience or cut up spare copies and file them under species. To do this as at present arranged needs two spare copies instead of one. Secondly the genus and species have been inextricably mixed up and only the context enable one to say whether a paragraph refers to the genus or one species of it. In the first species dealt with, *Juniperus procera*, the first 4 paras. refer to the species, the 5th para. refers to the genus, the 6th to the species, the 7th para. to both genus and species and the rest to the species only. Finally an indication of scale should be given on the figures. We have been unable to discover from the plate or text whether the pod of *Piptadenia africana* is natural size or enlarged or reduced. In the plate on page 27 called *Cæsalpiniaceæ* 146" we are told that all the figures are either enlarged or reduced and left to guess how much. Figures 1 and 2 are stated to be *Afzelia africana*. Presumably 3, 4 and 5 are *A. quanzensis*. If this is so the seed (figure 5) is not reduced but just the size of the larger seeds in a seed sample of this species. Perhaps all the figures refer to *Afzelia africana* but if so why is the plate called "*Caesalpiniaceae* 146"? The number is the serial number given to *Caesalpiniaceae* in Hutchinson's *Families of Flowering Plants*.

R. N. P.

EXTRACTS.

A REMARKABLE WOOD.

Balsa wood, of which there are several varieties, is very widely found in the States of Central and North Southern America. The best is said to come from Ecuador, and carries the botanical name of *Ochroma lagopus.* It is also found in Trinidad, Honduras, Brazil, etc., but experience has shown that the timber from those countries is generally much heavier and harder than that from Ecuador. The lightest timber requires a climate which is extremely hot and has a very heavy rainfall at the same time, and Ecuador has this for three months in the year.

The name " balsa " is a Spanish word for raft, for the old conquerors noticed that the Indians used this very light wood to build rafts on which they lived and travelled. They still, in fact, use balsa wood logs for the same purpose. Attempts have been made to grow this tree in the Botanical Gardens at Kew and also in the United States of America, but so far the only success which has been obtained is to get a small plant which grows up to about 3ft. in height.

In the early days of the marketing of balsa wood, reliance was placed on the natural supplies which are found in the primeval forests covering a large part of the world where the timber grows. Its growth is extremely rapid, as can be seen when the grain of the wood is examined, a tree of 50ft. in height and 3ft. diameter being obtained in about four to five years. The best timber comes from trees about four years old, and planks are obtainable which are as light as 4lb. per cubic ft. In such wood the empty cells of the timber can be seen quite easily, and any such wood is remarkable for the rapidity with which it will absorb water.

There is not a great quantity of this timber available. It was realised, however, some years ago that the natural supply of the timber brought in by the Indians would

soon include very young and immature trees, therefore a considerable amount of experiment was carried out to obtain balsa wood planted in selected ground from seeds taken from the wild variety, the growth of the timber being very carefully observed, and the trees only cut when they reached maturity. By this method a very great deal has been done in improving the standard of the timber exported, and the parcels of timber now being received in this country are of very high quality and contain planks as long as 18ft. × 18in. ×5in. thick. These planks are entirely free from splits and thunder shakes, and a boy can put one of these planks on his shoulders without feeling the least strain. The average weight of the timber works out at about 7 to 8lb. per cubic ft., and has considerable strength, which is utilised in all sorts of constructional work in boxes, chests, panelling, etc. As a comparison cork weighs about 11 to 13lb. per ft. cub., and has very little constructional strength.

On being felled the timber is stripped of its bark, is very full of sap and consequently very heavy compared with the dry wood. It is logged down to the coast, in the same way as many other varieties of timber, and is ripped up into rough sawn planks 6ft. to 15ft. long, 6in. to 15in. wide, and 1in. to 4in. in thickness, and shipped in that condition.

In industrial life, the timber is being increasingly used and is found in aircraft work both full size and model; plywood for aircraft, boats, trunks, panelling, etc., and packing for all types of highly polished and delicate objects, as the silky texture of the timber does not scratch a surface however smooth. It is used as sound proofing for rooms, electric motors, etc., insulation against heat for all classes of insulation work, particularly in connection with cases and vans, as the saving of dead weight is considerable. In regard to its thermal conductivity, it passes heat at the rate of 0·31 B. T. U. per hour per sq. ft. of timber in 1in. thick panels. It is also used to a small extent in certain wireless apparatus for use as the diaphragm, owing to its comparatively high modulus of elasticity and in another direction in X-ray work, where it is cut up into very fine strips, and also for making up into surgical boots and apparatus. Increasing inquiries are also being received by the Balsa Wood Co., 4, Great Queen Street, Kingsway, London, W.C. 2, who handle the wood in this country, from boat and yacht builders.

(*Timber Trades Journal*, 25-6-32.)

[This tree was introduced into India in 1800 and was grown in Calcutta up to 1873. It has been tried several times in Dehra Dun by the Forest Botanist, but the seedlings have always died late in November as soon as the night temperature falls to 40°F —Ed.]

THE VALUE OF 'PROTECTIVE' ADAPTATIONS OF ANIMALS.

One of the hypotheses on which the theory of natural selection is based consists in the interpretation of the coloration and general appearance of animals from the point of view of protection from enemies. The range of 'protective' devices considered to be sufficiently effective as factors in the selection is very great, but exact investigations aiming at proving that such devices actually protect their possessors are scarce.

Selectionists assume a discrimination in the choice of prey on the part of predators, and one of the methods by which the existence of such a discrimination can be tested obviously consists in studies on the food of predators, by analysing the contents of their stomachs. Results of the studies, however, can only be convincing if the series of records are sufficiently long to eliminate the accidental and to arrive at statistically sound conclusions. In this respect, the investigations on the contents of birds' stomachs undertaken by the U. S. Bureau of Biological Survey * are beyond reproach, for they cover a period of more than forty years (since 1885), during which about 80,000 birds have been examined and as many as 237,399 identifications of animals found in their stomachs made. A common objection to this method is that anything found in a bird's stomach would be in an unrecognisable state. This, however, proved to be a misconception, since most birds swallow their food whole, and even in the cases of the most fragile insects, such as butterflies, certain parts, for example, wing scales, are perfectly well preserved, so that an approximate identification is possible.

The first conclusion arising out of the accumulated data is that the animals serving as food for birds belong to all the systematic groups of the animal kingdom from protozoa to mammals. Within the size limits, animals of practically every kind accessible to birds are preyed upon, so that no groups can be considered immune from their attacks. Still more significant is the conclusion, supported by abundant statistical data, that the number of captures from each group is in proportion to the abundance of animals of that group. The figures for insects are particularly striking. Records for Rhynchota, for example, constitute about 11 per cent of all records of insects found in the stomachs of birds, and the percentage of known species of Rhynchota in relation to all known insects is about 8 per cent; the respective figures for Lepidoptera are 9 and 15 per cent; for Coleoptera, 44 and 46 per cent; for Hymenoptera, 14 and 17 per cent; and so on. This means that various animals are captured by birds approximately in proportion to their numbers, and no selective discrimination between groups on the part of birds is apparent. In other words, the predation takes place in much the same way as if there were no such thing as protective adaptation.

As regards various devices interpreted by selectionists as protective, their value can be gauged by the relative abundance of animals with such devices in birds' stomachs. The data in this respect are very discouraging to selectionists. It is not surprising, of course, that animals with coloration harmonising with their surroundings are eaten freely, since this can be interpreted as the selection in action. Much more important is the fact that animals presumably protected by poisonous secretions are also consumed in proportion to their numbers and, therefore, cannot be said to enjoy any protection. A beetle, *Macrodactylus*, is definitely poisonous and many young birds are killed by eating it, but it is, nevertheless, eaten freely, and the advantage of being poisonous is not obvious. Again, all spiders are venomous, but the 10,000 records of

* Smithsonian Miscellaneous Collections, vol. 85, No. 7, "Effectiveness in Nature of the so-called Protective Adaptations in the Animal Kingdom, chiefly as illustrated by the Food Habits of Nearctic Birds." By W. L. McAtee. pp. 201. (Washington, D.C.: Smithsonian Institution, 1932).

spiders having been eaten by more than 300 species of birds emphasise the complete disregard by birds of this method of protection. All the members of the group of Rhynchota (bugs) are always regarded by selectionists as being specially well protected by their taste or unpleasant smell. The fallacy of this statement is made clear by the 22,395 records of Rhynchota found in stomachs, the percentage of the records being in close agreement with the relative abundance of these insects.

Bright and contrasting colours of insects are usually considered as 'warning', and the Coccinellid beetles, or ladybirds, represent a classical example of 'warning coloration', possibly developed by selection and serving to advertise their unpalatability. There are, however, 1,455 records of Coccinellids found in the stomachs of 127 species of birds; since up to 15 insects have been found in one stomach, their 'warning' coloration and the inedibility must be a fiction. Another equally well-known example of a specially protected group of insects is represented by the ants, and their immunity from attacks is said to be so great that many other arthropods secure protection from enemies by mimicking ants. The 12,000 records of ants eaten by well over 300 species of birds make the status of ants as a protected group untenable. Some birds eat ants in very large numbers, and up to 2,000 ants have been found in one stomach. It is particularly noteworthy that even ants of the family Myrmicidae, notorious for their stinging habit, are not avoided, as is shown by 1,200 records of their presence in stomachs, containing in some cases up to 400 individuals. Wasps are considered also as regular models for mimicry, being themselves presumably well protected by sting and also 'warningly' coloured, but 140 species of birds eat them, up to 30 wasps at a meal.

The whole book is full of examples of this kind, most carefully collected and thoroughly analysed, and represents an array of arguments of which selectionists will find it very difficult to dispose. The principle of proportional predation is exhibited so clearly and forcefully that a discrimination in the choice of prey by birds (and other vertebrates, also considered in the paper) is shown to be simply non-existent. Indeed, the data at hand denote a complete indiscrimination, the very antithesis of selection, and the phenomena classed by theorists as protective adaptations are shown to bear no relation to the survival of the fittest.

B. P. U.

(*Nature*, 9-7-32.)

FORESTRY AT THE SHOWS.

For many years the forestry exhibitions at the great agricultural shows have formed one of the chief attractions not only to foresters, landowners and their agents, but also to the general public. There is probably no better method of educating "the man in the street" as regards the value of forestry, and it is unfortunate that the organisers of these sections are finding it increasingly difficult to obtain entries. Whilst this difficulty is largely a sign of the times, it is also due to the lack of imagination of foresters themselves, who seem unable to realise that whilst certain things have little interest, so far as they personally are concerned, such things might, and generally are, of great interet and possess definite educational power when shown to people who

know little or nothing about the subject. In England large forestry shows are generally staged by the Royal Agricultural, Bath and West, and the Royal Welsh Agricultural Societies. Of these the Welsh had no forestry show this year, and the Bath and West was definitely curtailed and, apart from gates, possessed no estate entries. Exhibits in the Royal Show at Southampton, however, were much more numerous than at Warwick a year ago.

At the Bath and West, held at Yeovil in May, two exhibits stood out above all others —a model planting area, built up by the Forestry Commission, and a collection of pit timbers, shown by the Powell Duffryn Steam Coal Co., Ltd. The Commission's exhibit, which covered considerable floor space, portrayed a typical area in the south-west of England, including hills, valleys (plantable and unplantable), land, water, meadows, etc. On each area fit for planting, the species considered suitable was shown by means of seedlings and young transplants. The Powell Duffryn exhibit was of a distinctly original type, consisting largely of props and other mine timbers drawn from one of their Welsh pits in order to show the appearance of the timber after it had been actually used for the purpose of coal mining.

New Norway and French props were also shown, it being stated that they were preferred owing to comparative cheapness and superior grading. When it is realised that this mining group uses over 100,000 loads of timber per annum, these advantages are important. A full sized brake block of home-grown poplar was also shown in position on a model in wood of the pit head winding drum for lifting and lowering the cages. This exhibit was awarded the Society's Gold Medal as being the best in the pavilion.

The Great Western Railway staged their large collection of items connected with railway work, which received an award, as did the British Wood Preserving Association's exhibit dealing with the various methods of protecting lumber from water, fire, etc. Perhaps the most interesting item in this exhibit was the fence poles which had been boiled unseasoned, this being in direct opposition to the usual practice. By cutting out sections of these poles it was possible to see that penetration was quite sufficient to ensure protection from dampness, etc.

The forestry exhibit at Southampton was the largest the Royal Agricultural Society has put up for many years, and it was in the 'fortunate' position of being forced to refuse exhibits owing to lack of space. In the plank classes the items numbered 91, and in the yard there were about 40 gates.

In the non-competitive section, Tagart, Morgan and Coles, Ltd. of Basingstoke, entered a collection of planks of the definitely commercial species. This, coming from a trade source, aroused considerable interest, and it is hoped that the example of the company will encourage others to exhibit in future years. Much has been talked of the lack of liaison between merchant and grower, a lack which is to be deplored as, after all, the home-grown timber merchant depends on the grower for his supplies. Interest by the buyer in the work of the grower lends encouragement to his work, and encouragement means improvement, for which there is very definitely room.

Gates, on the whole, were good, but in one or two cases there is still a tendency to use a projecting timber catch that might mean disaster to anyone putting a restive young horse through by catching the boot. An attractive hunting gate, erected by the Winchester College Estates, had the school motto carved on the top bar. This motto, "Manners makeyth man," is to-day singularly apt for use on a hunting gate.

Two interesting exhibits were shown outside by the Southern Railway Co. The first from the Mechanical Engineers' Department was a 15-ton stone wagon, the underframe of which was carried out in home-grown oak. This exhibit was shown standing on rails set on sleepers lying in correctly ballasted permanent-way. The other, shown by the Docks Department, Southampton, was distinctly unique. Its object was to show the use of underwood fascines as a preventative of bank erosion whilst dock walls are being built. Over 10 acres of bank have been protected at Southampton in this way. The exhibit which showed a complete section, contained between 40 and 50 loads of shingle and gravel, and explained very clearly the method of forming the foundation and fixing the completed mattress.

The exhibit by the Empire Forestry Society was new and of the best. It comprised examples of Empire timbers, suitable for work in this country, shown polished and unpolished. No species was shown that cannot be obtained in quantity from ordinary commercial sources. This in itself is a distinct advance on many previous Empire timber exhibits. In the panels and doors, the Empire "walnut" and Andaman greywood were perhaps the most striking, although in the writer's opinion the door in greywood would have been better without the ebony beading. The successful use by Burroughs and Watts of white mahogany in place of Spanish mahogany for billiard markers was particularly noticeable. The innumerable boxes turned by Mr. A. L. Hetherington, of the Department of Scientific and Industrial Research, to show the turnery qualities of Empire timbers, had been lent by the South Kensington Museum.

The Forestry Commission had a large exhibit, both indoors and out. Their chief section dealt with the production of Scots pine for G.P.O. telephone poles, an outlet for estate timber which is comparatively new.

The Chartered Surveyors' Institution dealt with bat willow timber on a large scale. Clefts showing every known defect were shown, also examples of good class willow from counties outside East Anglia, such as Surrey, Berkshire and Gloucestershire. The progress of a first-class bat was shown from the original crossing of white and Bedford willow to make the "Bat" willow through the set and final cleft to the bat.

(*Timber Trades Journal*, 16-7-32.)

DOMESTIC OCCURRENCES.

Birth.

Holberton.—On July 2, 1932, at Maymyo, Upper Burma, to JOAN MARGARET (*nee* Hopwood), wife of N. V. HOLBERTON—a son.

Death.

Chester.—On the 15th July, at Barkway Cottage, Horsham, Edward G. Chester, Conservator, Imperial Forest Service (retired), son of the late Granado Chester, Honourable East India Company's Service, in his 80th year.

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FOREST PRODUCTION AND THE TIMBER TRADE.

The effects of the economic depression were just beginning to be felt when Russia, which before the War was Europe's principal source of supply, reappeared in the timber market. Since the war, her exports to Europe had almost ceased, and the stoppage of those exports had stimulated the production of sawn wood in other countries. From 1927 onwards her exports rapidly increased. The 955,000 standards exported by her in 1931 represented approximately 20 per cent. of the world's timber exports. With the gradual decline in consumption the expansion of Russian exports made competition keener, and the export figures for all other timber producing countries show heavy drops, often as much as 50 per cent. between 1927 and 1931. The most disquieting feature of the situation however is that the rapid reduction in the quantities exported has in no wise prevented a steady decline of prices, due to the fact that the power of consumption has decreased more than the supplies available, and this collapse of prices is accentuated by wild competition.

The crisis through which the whole timber industry is now passing is of a paradoxical nature. On the one hand, general over-production is depressing the market; on the other hand, it is generally admitted that the normal world consumption of timber, although it has now been reduced as a result of the general economic depression, still exceeds the possibilities of natural growth of the forests which are economically capable of exploitation. Over-exploitation may one day lead to a shortage of timber. For a long time past economists have been taking alarm at the shrinkage of forest reserves, the normal world consumption being put at a billion and a half cubic metres against only a billion cubic metres obtainable from normal fellings, the other half billion coming out of forest capital through over-felling.

The anxiety of countries whose prosperity largely depends upon their forest resources is understandable, and it has been increased by the restrictive measures suddenly adopted in certain countries for the purpose of preventing excessive imports and protecting home production against the effects of the fall in prices. In order to surmount these barriers of increased customs duties, exporters have lowered their prices still further. Further, the quantities unsold after the inadequate quotas have been exhausted depress both the market of the exporting country and the markets in which the latter endeavours to dispose of its surplus output. We thus see that even customs barriers are powerless to avert a crisis which is becoming more and more acute. Timber problems have ceased to be purely national economic questions and have become an international affair, as is evidenced by the fact that the League of Nations has appointed a Committee of Timber Experts.

In view of the impossibility of influencing demand, this committee of experts recommended, at its meeting in April 1932, that the immediate measures to be taken should be confined to a voluntary restriction of supply. Such measures can only be adopted on an international basis, and for obvious reasons must entail sacrifices on the part of all concerned. To achieve this purpose, two means are possible :—

(*a*) reduction in fellings ;

(*b*) reduction in exports, or, more accurately, in the supply for export.

The first measure is equivalent to a reduction of the supply in general, and the second to a reduction of the supply in the international market. However the committee admits that, as things are at present, a concerted restriction of fellings does not appear to be a practical proposition. It is very difficult to interfere with the forest policy of each country, and states possessing very large timber reserves refuse to take any action in the matter. The experts agreed that, failing any restriction in regard to exploitation, the regulation of exports might assist the recovery of the market, and further meetings have since been held to determine the capacity and percentage to be allotted to the various importing and exporting countries, but in actual practice the

limitations will depend upon how far the various commercial bodies, and particularly the Soviet export organisations, are prepared to reduce their export activities by means of commercial agreements with the exporting organisations of other countries.

Fortunately for us, India is largely self-supporting in timber, so that these happenings have had less direct effect than in wood-importing countries. Local markets have been chiefly influenced by the general lack of purchasing power and the cheapening of wood substitutes like concrete and metals, rather than by competition with other wood supplies, though in certain instances there has been cut-throat competition, as in the case of Kashmir and the Punjab competing for the Northern Sleeper Pool, and in places where neighbouring forest divisions are competing in a common market.

Of the two alternatives suggested by the Geneva Committee the second, namely reduction of exports, has already been effected, not through any effort of the forester, but through the market changes which have curtailed Burma's teak exports. The other head, namely reduction in fellings, is a matter which lies in the hands of the provincial heads of the Forest Department. In some of our divisions forest staffs are working hard to fell and bring out timber of a class such as we are unlikely ever to produce again, merely to sell it for an old song or to watch it rot unsold in a depot. We suggest that the present dull market conditions make an excellent opportunity for genuine retrenchment by conserving the forest output at least until better times arrive. On the other hand, many of our divisions are not working up to their full possibility, and in such cases the need is not to curtail the output but to encourage and develop new markets for forests produce which at present is unmarketable.

It is one of the basic facts of industrial practice that a dull market period is the time for reorganisation as well as retrenchment, and in this our forest industry is no exception. We recommend that a detailed survey be undertaken by the combined forces of working plan and utilisation experts to determine the exact field in which closer utilisation of our dormant forest possibilities is needed. The ordinary divisional officer travels about so little outside the immediate vicinity

of his forests that the present rapid development in building and industrial activity in many parts of India is not fully realised, and we are thus losing golden opportunities for developing new markets. As an example we might refer to the innumerable sugar factories which are springing up like mushroom growths all over the country. How much local timber is being used in these factories? Literally none. And why? Because no effort has been made, so far as we are aware, to demonstrate the usefulness and cheapness of local timbers as compared with concrete, brick and metal, for the particular needs of these factories, such as copious storage accommodation and cooler living and working conditions for the workers.

A SIMPLE METHOD OF MEASURING SMALL AREAS.

By L. N. Seaman, M.E.I.C.

It is probable that few, if any, forest officers know that they possess, in an ordinary two bladed pocket knife, an instrument for making reasonably accurate measurements of small areas on maps, drawings, and the like. It is a fact, however, that a pocket knife and measuring scale can be used for this purpose, and that areas so measured, with reasonable care, will be correct, generally, to a degree limited only by the graduation and accuracy of the measuring scale and the skill of the operator.

The Method.

The method of making the measurement is extremely simple. Locate roughly, by estimation, the centre of the area to be measured, and draw a straight line from the point so located to any point on the boundary of the area. Open one blade of the knife straight out and the other so that it makes approximately a right angle with the handle. The knife is to be held as illustrated in Figure 2, *very lightly* by the partly opened blade, which may be called "the pointer." The other blade, which may for convenience be called the "runner", rests on its edge near its point on the paper. Placing the "pointer"

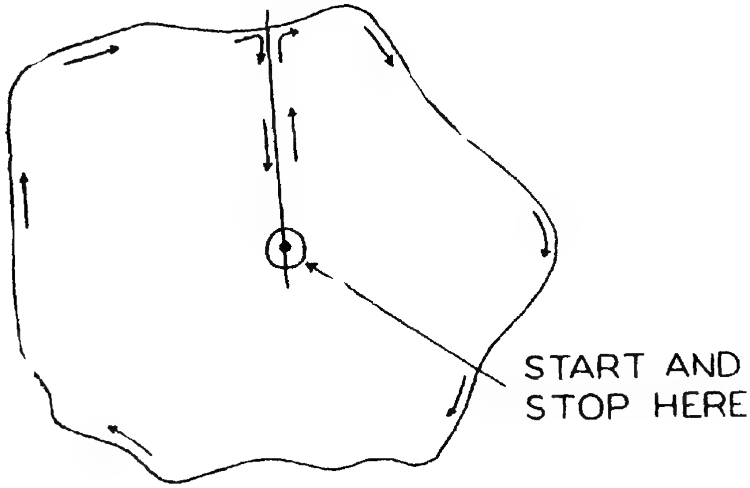


FIGURE 1

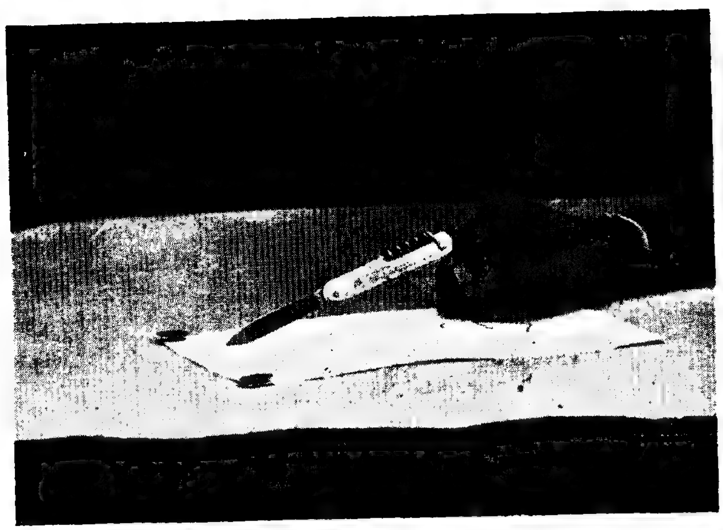


FIGURE 2

over the centre point of the figure press down the " runner " sufficiently to make a visible mark on the paper. Then very lightly and *without causing the " runner " to slip sideways* trace with the " pointer " along the straight line from the centre to the boundary of the figure, round the boundary, and back along the straight line to the starting point at the centre, as indicated in Figure 1. When this is completed press down again on the " runner " to make a second mark on the paper. The distance between the two marks made by the " runner " multiplied by the distance of either of them from the starting position of the " pointer " is the area of the figure. If the distances are measured in inches, the area is in square inches, if measured in centimeters the area is in square centimeters, and so forth.

Limitations of the Method.

This method of planimetry is not new. Prof. Sparks of Yale University says of it :—" This use of a penknife is known as the hatchet planimeter, and though it was devised long ago it has not become generally known because of the complicated theory and the many commercial types of planimeter which are simpler." Its application is limited by, (*a*), the size of the figure to be measured, (*b*), the accuracy and graduation of the measuring scale, and (*c*), the skill of the operator.

(*a*). In size the distance from the starting position of the " pointer " to the most distant part of the boundary should not, for accurate determinations, be more than one-eighth of the length from " pointer " to " runner." Larger areas can be sub-divided and measured in parts, or a larger knife can be used. As the size of the figure is increased in proportion to the length of the knife, accuracy is reduced. If the greatest distance across the figure equals the length of the knife and one open blade the error due to this cause will be about 6 per cent if the area is based on two readings in which the boundary is traced in opposite directions. Another reason for using a large knife is that it will be found easier to manipulate a heavy knife without causing the " runner " to skid.

(*b*). A scale of millimeters or a scale of inches and hundredths is most suitable for making the measurements, to avoid too much

interpolation on the part of the operator. As the " runner " makes rather a long mark in the direction from " runner " to " pointer," it is probably best, in making this measurement, to point off both ends of the " runner " mark and measure from the " pointer " mark to a spot half way between the ends of the " runner " mark, *i.e.*, to measure from the " pointer " mark to the *middle* of the " runner " mark.

(*c*). The skill of the operator affects the location of the centre of the figure, the making of measurements, and the manipulation of the knife. The nearer the starting position of the " pointer " is to the centre of the figure, the more accurate is the measurement of the area. This, however, is not a matter of great importance, as a variation in this respect produces only a very small error It should not be necessary to emphasize the importance of careful and accurate measurement of the lengths employed. The most essential point, as far as the skill of the operator is concerned, is the holding and use of the knife in order to *avoid the slightest skid of the " runner."* The " pointer " should be held very lightly and gently as indicated in Figure 2, the blade and perhaps the end of the handle resting against the index finger. With a little practice it is possible to measure areas in this way with as much accuracy and with very little more trouble than with most commercial planimeters.

The mathematical proof of this method of planimetry is based on the equation of the " curve of pursuit ", the path of the " runner " in response to movement of the " pointer," and is much too complicated to be included here. Anyone who is interested, however, can find an excellent note on the subject by Robert Sparks, E.E., in the *Journal of the Franklin Institute* for June, 1932.

In the equation developed in the mathematical proof it is found that the product of the two measurements employed is equal to the area of the figure plus certain other very small quantities, which are reduced in value as the starting position of the " pointer " is brought nearer to the true centre of the figure. All these are small enough to be neglected except when the width of the figure is large in proportion to the length of the knife. One of them, moreover, is expressed in the

form of a series involving odd powers only. Because the series contains only odd powers its value will be positive when the " pointer " traces the figure in one direction, and negative when the boundary is traced in the opposite direction. Consequently, when the figure is sufficiently large to cause doubt of the accuracy of the method, a closer approximation of the area can be obtained by making two determinations, in one tracing the boundary in the clockwise direction, and in the other in the anti-clockwise direction, and computing the area as the mean of the two. In this way the excess expressed in the series, being positive in one case and negative in the other, is cancelled in the mean.

PANCHAYAT FORESTS IN KUMAON.

By A. E. Osmaston, I.F.S.

Readers of the *Indian Forester* will perhaps be interested to hear what is being done in Kumaon towards the formation of what are, in reality, communal forests, but known locally as panchayat forests, because they are managed by a panchayat or governing board composed of influential villagers.

The first active steps towards the formation of these communal forests date from 1929 when a special officer with the rank of Deputy Collector, who had already visited Madras to study the way in which this problem had been handled there, was appointed as Panchayat Forest Officer in Kumaon. His duty has been to tour throughout the hills of the Almora and Garhwal districts, to educate local opinion to appreciate the advantages of forest management, and to persuade the villagers, wherever circumstances seemed favourable, to undertake the responsibilities as well as the privileges of communal management.

The legal position as regards uncultivated land in the Kumaon hills is briefly that all such land is either reserved or protected forest under the Indian Forest Act. Reserved forest includes all those areas which contain forest of commercial value (termed class II

forests) as well as many others the value of which is mainly protective, or where the demand for forest produce is purely local (class I forests). This, at least, is a rough explanation of the broad lines of a classification which, in actual application, involves minor exceptions and variations according to local conditions. Protected forest, usually referred to as " C " lands, contains a large area of forest and grassland situated remote from habitations. It also contains extensive unculturable areas intersecting village cultivation, and frequently over-burdened with grazing and other rights of local villagers. Much of this class of land is barren, carrying little besides a scanty crop of grass and subject to destructive erosion. A considerable portion of " C " class land does however still retain the remnants of past forest, oak, *chir* or miscellaneous species as the case may be, in various stages of destruction.

The class II forests are managed directly by the Forest Department. They have been so managed for the past 15 years, and for the purpose of this article may be regarded as including some older reserves which have been managed for a much longer period. The class I forests are managed by the Deputy Commissioner, but management is practically restricted to the protection of a few comparatively rare species like deodar and cypress, and to the prohibition of cultivation. Lopping and felling are otherwise unrestricted, whilst grazing and grass cutting are for practical purposes unrestricted in both class I and II forests, though they may be, and often are, restricted in regeneration areas of class II forest. All " C " lands are also under the Deputy Commissioner, but here the villagers are in practice given a free hand. The greatest need for panchayat management is therefore in the " C " lands, and to a slightly less extent in the more accessible portions of the class I forests.

To fully appreciate the difficulties of forming panchayats, it is necessary to understand village life and sentiment in so far as it affects the villager's attitude towards forest conservancy and towards his neighbour. In spite of a strong patriotism uniting the villages of one tract, yet each village has far stronger internal ties and the village boundary is something infinitely more important than a mere demarcation of land. All land in the hills, whether cultivated or

not, has from time immemorial belonged to one or other village and in Sambat 1880 (A. D. 1825) the inter-village boundaries were made permanent. Each village therefore claims a special measure of control as regards the use and distribution of forest produce within its village boundary, and in proportion as the forest disappears and competition becomes more acute, each village tries to assert its claim to exclusive user within its own territory.

In class I and II reserved forests, the fact of legal reservation under the Act and the existence of a record of rights by forest blocks is generally regarded as having, legally at all events, destroyed any exclusive rights of a villager within its own territory now included in reserved forest. This position has been accepted by the villagers as regards class II forest under the management of the Forest Department but in class I forest and all class " C " lands the position remains much as it was prior to reservation. Thus each village tries to keep the forest produce within its own territory to itself, and this should tend to encourage conservation and protection of their natural resources. Unfortunately it is rare for a village to entertain such advanced ideas, and even when the desire is present, the ability to put these wishes into practice is absent. The existence of village factions, whose interests are sufficiently divergent to foster and breed distrust, is perhaps the greatest difficulty with which the village is faced. Moreover, the individual, in common with most hill people, is very independent by nature and the instincts of concerted action for the good of his community as a whole are foreign to his nature. Nevertheless there exist, as exceptions to prove the rule, most praiseworthy results arising from combined village action. As might be expected, these examples are mainly restricted to heavily populated tracts where extreme necessity has overridden all other interests, and here may occasionally be seen a carefully preserved oak forest lying close to the village like an oasis surrounded by a desert of bare land and cultivation : or a deodar grove, protected to some extent by the special sanctity accorded to this tree, may have attained the proportions of a small forest ; or perhaps a strip of bare hill side will have been annually protected for the sake of its grass alone.

Nevertheless it may be taken as an axiom that there has never been any general idea of preserving the forest from destruction for the sake of future generations, and so long as present wants are satisfied, no thought for the future has ever been taken. It is this utter lack of forethought which still constitutes a main barrier to the progress of the communal forest movement. The movement is therefore faced in the first place with indifference to the future so long as present needs can be reasonably satisfied, and in the second place to an absence of strictly communal feeling even within the boundaries of one village ; whilst any scheme involving several villages has to overcome the traditional antagonism separating village from village and preventing that close partnership which seems essential to success.

There is, however, a brighter side to the picture and the labours of the Panchayat Officer during the past five years are undoubtedly beginning to bear fruit. The actual formation of panchayats commenced in 1929, and during the year ending October 1930, forty panchayats had been formed. By July 1932 the number of panchayats had more than doubled, and of these about 75 per cent. are regarded as likely to succeed. The size of a single panchayat has varied from a few acres to 2,500 acres, and may involve one or several villages. Nearly three-quarters of the panchayats have so far been in "C" class land as, owing to the villagers' apathy so long as their immediate needs are satisfied, the villagers cannot ordinarily be induced to accept responsibilities which curtail rather than improve their present prospects. The more active panchayats have already made good progress. Some 8 miles of stone walling has been completed, and one panchayat has purchased a quantity of second-hand barbed wire from the Forest Department. During the first two years we supplied them free with 12 maunds of *chir* seed and there are signs that this demand will increase rather than otherwise. Forest watchers are appointed permanently by all the larger panchayats, and in the smaller ones the *panches* (members of the board of control) elect one of the villagers by rotation. Each panchayat maintains a minute book, cash book, pass book and receipt book.

The progress so far obtained is not limited to the panchayats themselves. The exhortations of the Panchayat Officer has led many

other villages to commence afforestation and protection even though their peculiar circumstances do not encourage the villagers to form a recognised panchayat. This movement is receiving the recognition it deserves and may prove just as valuable as the panchayats themselves. In a few instances the Forest Department have handed over to the villagers isolated plantations on which considerable sums of money had already been spent, and there is every indication at present that these will continue to be managed satisfactorily by the villagers. One particular panchayat is, I think, worth special mention. At the forest settlement 15 years ago some comparatively small, but commercially valuable, *chir* forest had been left unreserved. This was formed into a panchayat composed of neighbouring villages whose timber requirements were far below the possibility of the forest and whose main desire was for a good water supply. The Forest Department are now carrying out scientific fellings on behalf of the panchayat, and are realising the sale proceeds which are being credited to a panchayat fund account. In a few years this account will have sufficient funds to build a pipe line estimated to cost about Rs. 20,000 for the supply of water to the villagers concerned. This example should help to make the villager recognise the value of his forests.

There is little more of general interest to record and I will conclude by giving a precis of the principles involved in the new Kumaon panchayat forest rules which were passed in July 1931.

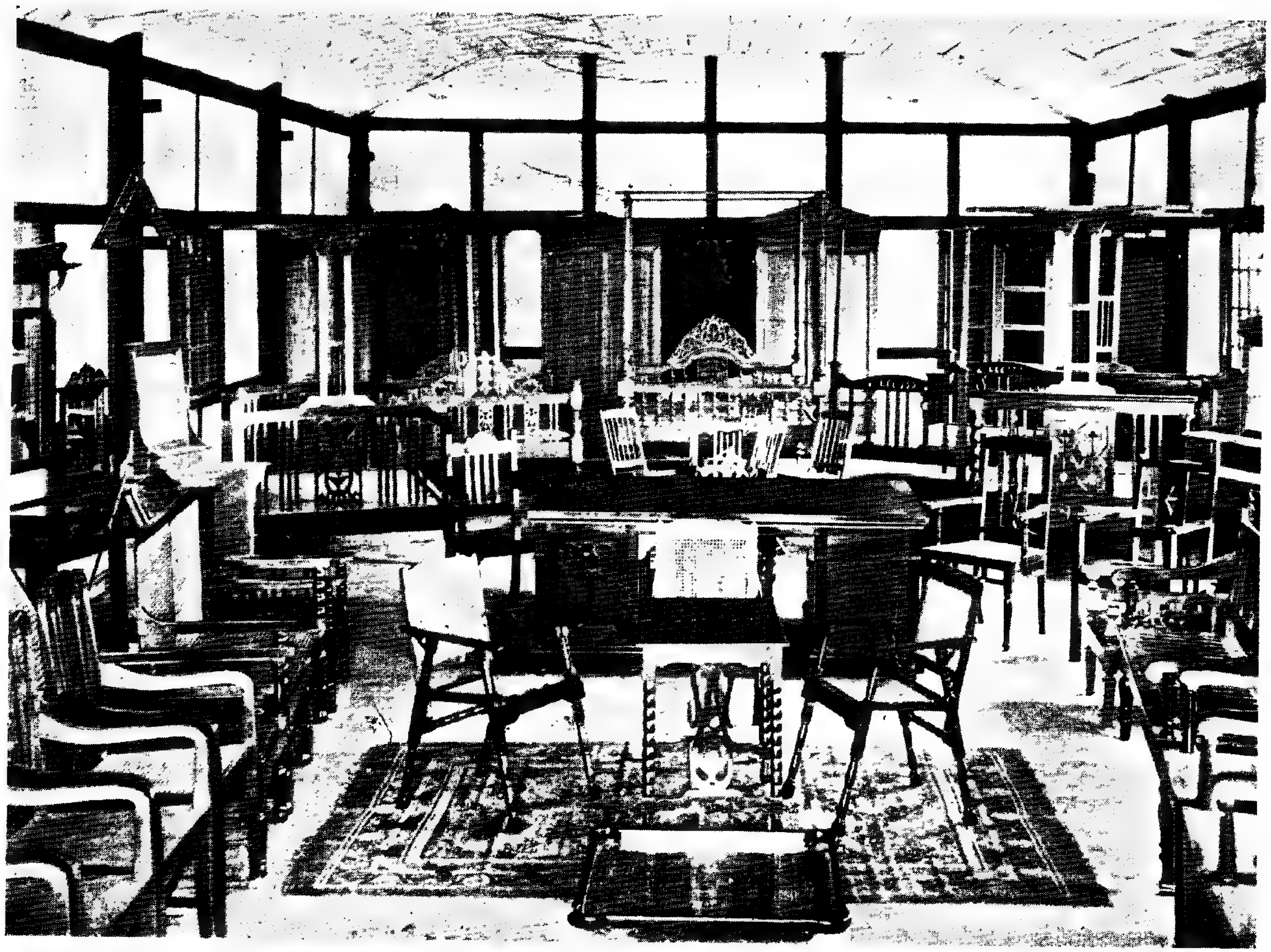
The rules give power to the Deputy Commissioner to form panchayats, but they provide that if a special officer is appointed, such as the Panchayat Forest Officer, he shall exercise all these powers. In practice, the latter has up to date been the active official in this matter, though forest officers and others have assisted by bringing likely areas to his notice. The Panchayat Officer goes to the locality and commences by making a village to village and house to house visit, personally explaining to the villagers the advantages of forest protection or afforestation as the case may be, not forgetting to explain also the responsibilities and restrictions attached. If he finds the villagers willing to form a panchayat, he proceeds to hear claims and objections and also demarcates the proposed forest. He decides

all claims on the spot. He then collects the villagers from those villages whose land has been included in the forest, and makes them elect a panchayat consisting of not less than three or more than nine *panches* (controlling officers). These officers subsequently elect a *sarpanch* or president. The Panchayat Officer then draws up an agreement for signature by the members and the *sarpanch*. This agreement is extremely simple. It prohibits cultivation and reckless destruction of trees, and provides that the orders of the Deputy Commissioner or Panchayat Officer for the preservation and improvement of the forest are to be carried out. The members of the panchayat serve for 3 years. They have the status of a forest officer and may prosecute for forest offences, sell forest produce, impound cattle and seize tools used in committing a forest offence. Power to compound offences and powers under Section 72 of the Forest Act are ordinarily exercised by the Deputy Commissioner or Panchayat Officer, but may be delegated by the Local Government to specified panchayats. The income of the panchayat is credited to a panchayat fund and is applied, firstly, to the improvement of the forest, the remainder being used in works of general utility. Since many panchayats will receive little or no income for some years, each village may have to make a small annual subscription to the panchayat fund for the maintenance of a forest watcher or for other necessary expenses. Forest Officials have no concern whatever with the panchayats though the Conservator and Divisional Forest Officer may, at the request of the Deputy Commissioner or Panchayat Officer, inspect and report on the working of any panchayat.

FURNITURE FROM INDIGENOUS TIMBER OF CACHAR.

By A. K. Adhikari, P. F. S.

Bhanga, a small village in the district of Sylhet, on the bank of the Kusiara, was the seat of the once famous veneer-making plant installed by Bhanga Saw Mill Co., Ltd. Unfortunately the 3-ply wood manufactured here did not meet the demand of the planters and the boxes, it was stated, stained their tea and spoiled its flavour. However



Show Room, Bhanga Cabinet Firm.

whether the cause was the box or the " bandobast ", the entire show failed miserably. The enormous capital sunk here can be easily guessed even now, seeing the quantity of costly plant still lying about. It remained a ghost-haunted place for a long time, until a few years ago the saw-mill section was bought up by Mr. N. C. Kaule, a rich timber merchant of Calcutta. The work was again started with Cachar timber, mainly depending on the supply of railway requirements, particularly timber for carriage building, of which E. I. Railway has bought a big quantity annually since timber other than teak has found place in their work-shops. But with the fall of demand due to the fall of railway earnings, and with an enormous quantity of seasoned timber in hand, the mill had to find some means of disposing of the small sized timber and other material not generally required by the railway. The manager, Mr. K. Sen, has partly overcome the difficulty by opening a cabinet making firm attached to the mill with indigenous timber and indigenous labour. I had recently paid a visit to the work-shop and I was impressed by the success achieved in such a short time. It has shown to the unsophisticated that better furniture can be produced at a cheaper price with timbers other than teak if only one has learned how to use them correctly. The timbers in use are :—

1. *Alseodaphne owdinii.*— The best all round timber of Cachar, used for all kinds of furniture.
2. *Michelia montana*—for dressing-tables, occasional tables and light tea-poys, chairs and ordinary tables.
3. *Cinnamomum cecidodaphne* and *glanduliferum*—wardrobes, almirahs, boxes and drawers, etc. ; keeps away insects.
4. *Artocarpus chaplasha.*— } Carvings and ornamental works ;
5. *Gmelina arborea.*— } also bedsteads.
6. *Chukrasia tabularis.*—Camp furniture : light but strong.

The photo shows a part of the show-room. The articles are good because the timbers used are seasoned ; they are cheap because the price of our timber is low as compared with Calcutta where the price of teak is high. So good are some of these articles that some Calcutta firm has placed orders evidently with the object of reselling them at

Calcutta at a much higher price. Perhaps to a gullible customer the timber of this very furniture would go under the name of "Kamchatka mahagony" or "Timbuctoo box-wood"! Such is the timber market. Such are our buyers. It is difficult to persuade people to believe that seasoned timber other than teak is equally valuable. Tradition and the backwardness of the trade are partly responsible for this. Any body who has gone round the carriage-building yard of E. I. Railway's work-shop at Lillooah must have seen how fine and varied some of our familiar timbers look, when they are kiln seasoned, worked, polished and varnished. Fifty per cent. of our so-called unmarketable timber would find a market if we could only sell them seasoned. It has been admitted by authorities responsible for buying large quantities of teak that blind adherence to teak is not economically sound, but they cannot break away from tradition. All this goes to suggest that some sort of propaganda work must be done to push our timber in the Calcutta market where its value is so little known. Railway freight is no doubt a handicap for Assam timber in competing with timber from the Andamans and Australia imported into Calcutta; but this is not an insurmountable barrier. If the value of our timber were fully known to the commercial world and a demand created, then only would our working plans work in their entirety. We have plenty of good hard-woods, and there is no dearth of well grown trees, but we have yet to develop a market for them.

EUROPEAN SILVICULTURAL RESEARCH—PART II, ROOT COMPETITION.

BY H. G. CHAMPION, I.F.S.

In the previous article, the tendency was noted to investigate more closely the subterranean parts of tree crops, and the medium in which they exist and extend. The soil being infinitely less homogeneous than the air, root systems cannot be so uniform as stem branching systems. A much larger number of examples requires to be examined in order to obtain an acceptable average and the variation

round that average is much greater. Exposing, examining and analysing the root systems of trees is a laborious process, but in the aggregate a large number have been so studied for the leading tree species of Europe and not a few in India, *e.g.*, teak, *sal*, *sissoo* and one or two others. The text books describe the main range of types and their significance, but do not really carry us very far. Special investigations, often undertaken incidentally to some other main object, have shewn that within a species there may be marked variations as in the instance of the ash races investigated by Münch and Dieterich. Here it was found that the race growing on dry limestone slopes characteristically develops a better more deeply penetrating system than the race growing naturally on deep alluvial soils— and so is definitely more resistant to drought. We might well have a similar phenomenon with species such as *Acacia catechu* which grow on fresh alluvium and dry well drained hill sides, and in others such as teak which occur in districts of widely different rainfall.

Corresponding with its greater density, the soil is much more fully occupied by the roots of plants than is the air with their aerial ramifications. It is as though systems comparable with the above ground parts of the forest with all its tiers were condensed from say their 120 feet into about 6 feet of soil. Investigations become the more difficult and while some workers have concentrated on disentangling the complex and studying it in all three linear dimensions and in time also, others have found it better to pay less attention to the root system as such, but to follow the results of influencing it through operations in the soil on the above-ground development which must be conditioned by these operations. It is this latter view point which has led to the various experiments made in recent years on root competition as a factor in regeneration.

Professor Fabricius of Münich shewed me in the forest an outstanding example conducted by him and recently published. It is worth describing in some detail as from the research technique view point it was as satisfactory a piece of investigation as any seen during my tours, and was at the same time exceptionally simple. The original object of the investigation appears to have been to determine the

relative importance of light intensity and root competition in the development of seedling regeneration under different overwood densities. Most of our present day regeneration practice concentrates on manipulation of light to the exclusion of almost everything else, or at least only considers alterations in other factors through the agency of variation in light, and the feeling has gained much ground of late that we have probably gone too far in this direction.

The problem thus started in general terms, Professor Fabricius set out to solve it in equally general terms. Preliminary studies had demonstrated that the operation of cutting a narrow trench one foot deep sufficed to cut the greater part of the roots of an overcrop of spruce, and if the soil was packed back did not appreciably affect the growth of existing seedlings on the side still exposed to competition. Some of these tests were seen and were conclusive enough : they were decidedly necessary as one would expect that the seedling roots would invade and benefit considerably from the worked soil thus made readily available to them.

Each experiment then consisted in trenching round a small patch of ground in this way and demarcating a foot or two away, on each side, a similar patch as control orientated with due regard to the neighbouring overwood trees. Duplicate sets of three such small plots were laid out under as similar light conditions as possible and there were eight or ten repetitions with different species. The whole series of plots as just described was repeated under different light conditions, roughly full shade, half shade and at the edge of the overwood.

The publication referred to (*Forstwissenschaftliches Centralblatt*, 1929, pp. 477—506, 2 coloured plates, 15 figures) should be seen for a full account of the outcome of this interesting investigation, but one does not often get results so striking to ocular inspection. The benefit to the seedlings of freedom from the root competition of the overwood was conspicuous in practically every instance and the apparent exceptions were equally instructive—they were primarily large-seeded species such as oak which for their first two or three seasons appear to be largely independent of supplies from the soil, and it was only a question of time before they too conformed in behaviour with the rest.

What it is that the competition is for is not proved in this experiment, whether it is water or oxygen or mineral food or mere room, but the progress of events just described for oak would suggest that it is not primarily for water which would be one's first guess. Comparable results were seen as a side issue of experiments on pine regeneration in the dry sandy soils of the Eberswalde forests where it fails in competition with the seed trees or adjoining crops.

Next as to the part played by light, the results are equally interesting. Here one sees typical light demanders such as *Robinia* progressing through their seedling development quite satisfactorily under a thick spruce canopy in the trenched plots, the untrenched controls being completely blank. The deduction is obvious that for some species at least, lack of light does not prevent development (upto a point of course). Scots pine failed in the shade even in the trenched plots shewing that light was probably the limiting factor for it here.

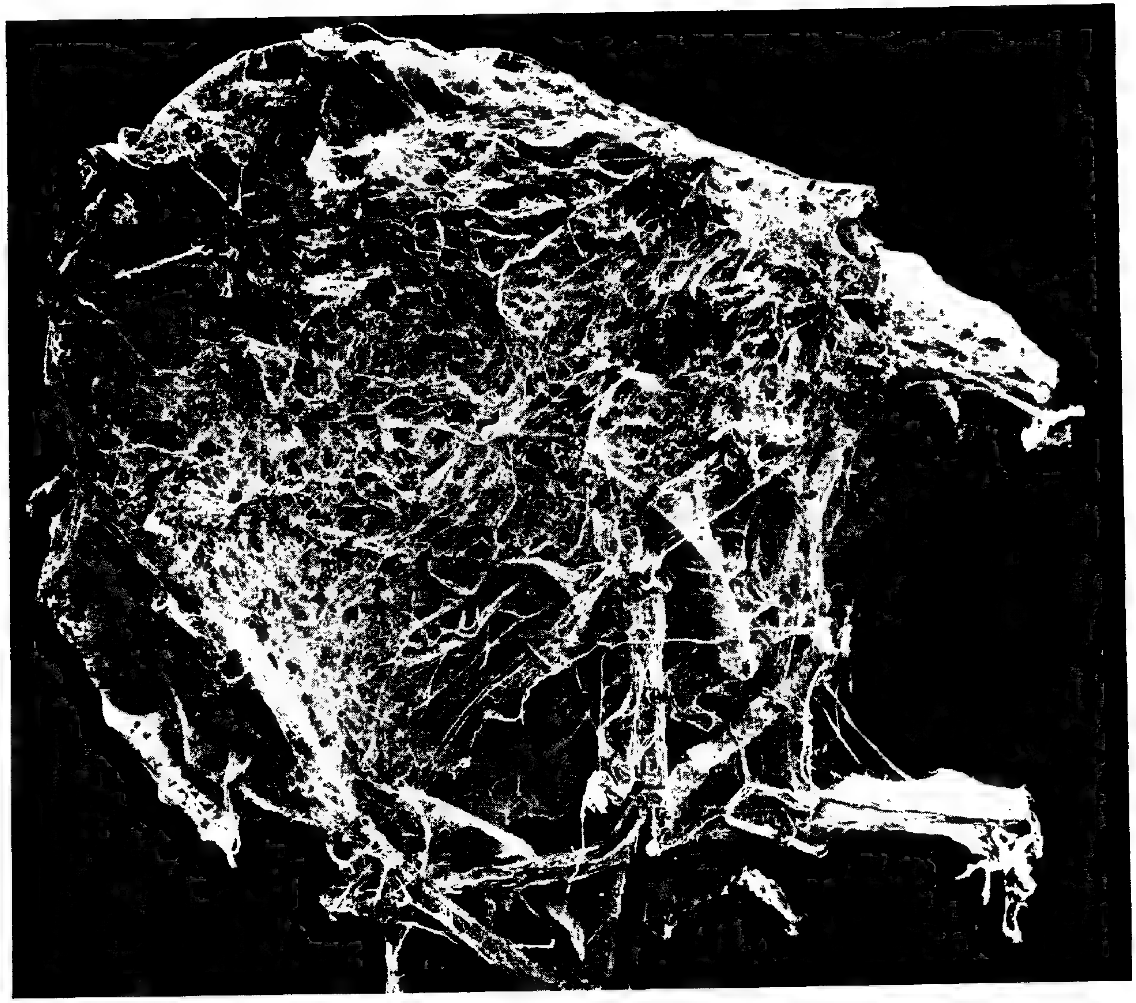
That difficult type of person who likes to think of himself as the purely "practical forester" is fond of trotting out his scoffing query as to what is the practical value of this information that a patch of seedlings will grow better if trenched, as if the experimenter was asking him to trench 1,000 patches per acre in his regeneration areas. In this instance, the results collected in the particular investigation described and the others like it carried out in various countries are pregnant alike with suggestions for application to practice and for further experimentation. Of the former, the chief is the question of the retention of standards over regeneration. For each species and set of conditions, it is clearly incumbent on us to determine to what extent retention of standards holds back the development of the regeneration beneath them, and if we find it does so appreciably, to evaluate loss in this way against gain in increment on the standards. I am indebted to Mr. Trevor for directing my attention to an Australian example of the extreme case where in certain *Eucalyptus* forests the only way of retaining and establishing regeneration is to clear fell the overwood directly the regeneration is obtained on the ground. Here competition is so great that limiting terms are reached and regeneration and overwood cannot coexist,

This development in forestry must have also an important bearing on other aspects of regeneration problems. This competition surely comes into play to an exceptional degree in all forms of regeneration based on making small gaps in the canopy and along the periphery of strips. Similarly, we have a suggestion for investigation of the commonly experienced failure along the edges of plantation areas adjoining unfelled forest or older plantations, failure which it is usually attempted to ascribe to shade, drip, reflection of heat and so on.

Further, there is the question of competition between similar individuals in small regeneration and all later stages. No direct investigation of this subject was encountered, though many cleaning and thinning experiments are dealing with it indirectly. It might be expected that such competition would be even more severe than competition between mother tree and offspring with perhaps rather differing needs and weapons. Many foresters favour leaving dense regeneration to fight it out, in the belief that this ensures victory to the strongest without their incurring any sort of injury or delay from the battle. Others feel that it is hardly possible that no appreciable benefit can come from liberating a selection of the seedlings from the competition of the rest, and so we find it an established practice in some divisions to thin out dense young regeneration to a prescribed minimum spacing at various intervals. Similarly, on this and other grounds, measures are recommended aiming at getting scattered regeneration in preference to thickets.

The only experiments I am aware of on this subject in India are some recently started by Mr. Parmanand Suri in the Punjab which I have recently been privileged to see. Recent as they are, they already give indications that marked differences will be found between trenched and untrenched plots under deodar. His replicated experiments on thinning young deodar regeneration to approximately $2' \times 2'$, $4' \times 4'$ and $6' \times 6'$ when about $1\frac{1}{2}' - 2'$ high should yield definite statistical information on this point also. It may be suggested that the matter is probably still more important in the dry-zone forests.

At the Forest Research Institute, unsatisfactory development along the edges of plantations of teak, *sal* and *chir* pine on south-east



Foliage and inflorescence of *Mangifera indica* showing damage done by web of *Stegodyphus sarasinorum* Karsch (Family *Eresidae*).

and north sides where adjoining (but not overhung by) old trees has been noted for several years, and it is intended to investigate the possibility of this being due to root competition though superficial examination does not reveal many roots of the old trees in question. We have also had experiments in progress for several years on the effect of thinning out seedlings in patch sowings on the development of those retained, but various mischances have prevented satisfactory completion.

An interesting and even important problem for India is the question of possible competition between plantation crop and soil cover crop where the latter is used for any of the several possible reasons. A year or two ago it was suggested that *Tephrosia* with teak competed with the latter for moisture after the close of the monsoon so effectively that the teak dropped its leaves several months earlier than it would otherwise have done and lost a proportional amount of growth. Examination of the experimental data shewed that, though the suggestion may be perfectly correct under local conditions, they did not warrant the conclusion, other causative factors not being excluded, but the fact remains that we have singularly little data to go on. It is a field where much research is required before we can hope for satisfactory general knowledge and explanation, research which must be done largely for its own sake, as early or direct economic returns cannot be expected.

A SOCIAL SPIDER AS A PEST OF MANGO TREES.

By Cedric Dover.

Stegodyphus sarasinorum Karsch (Pocock, *Faun. Brit. Ind.*, *Arachnida*, p. 209) is a common Indian spider, particularly in the southern part of the peninsula, where its tough, viscous nests may often be seen covering whole bushes and even large trees. The biology of this species is especially interesting because of its social habits and aspects of it have been discussed by Jambunathan (*Smiths. Misc. Colls.* XLVII, p. 365--372, pl. L), Fischer (*Journ. Bomb. Nat. Hist. Soc.*, XVIII, pp. 206-207), and Gravely (*Rec. Ind. Mus.*, XI, pp. 534—536, pl. XXV and *J. B. N. H. S.*, p. 1046, pl. 1, fig. 3). Hingston (*A*

Naturalist in Hindustan, pp. 189—208) describes the bionomics of an allied Indian species, while Marshall (*Zoologist*, 11, pp. 417—432) and Pocock (*Ent. Mo. Mag.* (2), XIV, pp. 167—170) note the habits of related forms in South Africa.

A remarkable feature of the biology of *Stegodyphus* is that, as in the case of other social arthropods, their nests (which prevent the escape of large insect captures) harbour certain inquilines which pass their life-cycle in company with the predaceous spiders. In Africa, the most interesting of these guests is a microlepidopteron (*Batrachedra stegodyphobius* Wals.), first discovered by Sir G. A. K. Marshall. In India, a similar species (*Brachmia xerophaga* Meyrick) was found by Mr. T. Bainbrigge-Fletcher to be common in the nests of *S. sarasinorum* (Meyrick, *Ent. Mo. Mag.*, (2), XXV, pp. 219-220), Fletcher, *Mem. Dept. Agric. Ind.*, Ent. Ser., VI, p. 86, pl. XX, figs. 1*a*-1*c*).

Reference to the literature cited will show that, while considerable information on *Stegodyphus* is available, its biology remains to be studied in detail, with particular reference to the trees on which it is most commonly found and the habits and life-histories of its messmates and parasites (if any). An added incentive for such work (an excellent subject for a student thesis) is the fact that *S. sarasinorum* is probably of some economic importance in agriculture and forestry, because of the rapidity and thoroughness with which its nests envelop the plants on which it lives. In Debra Dun, it is extremely abundant on mango trees (to which it is practically confined), large numbers of untended trees being entirely covered with the webs. The attached photograph shows how completely the foliage and inflorescence of a mango tree may be damaged.

For the identification of this spider I am indebted to Dr. Louis Fage of the Natural History Museum, Paris.

AN ECOLOGICAL CLASSIFICATION.

By E. A. Garland, I.F.S.

Mr. Hole in his note in the August number of the *Indian Forester*, on an article by Mr. Smythies under the title of "Sal and its Regeneration in the United Provinces," suggests that one of our chief

requirements at the present time is "the general acceptance of an ecological classification of our forests into main types differing widely from one another as regards the component species and habit of growth, *e.g.* Coniferous Woodland, Broad-leaved Deciduous Woodland, Broad-leaved Evergreen Woodland, Palms, Bamboos, Grassland and so on": in fact that floristic differences should form the basis of classification. Surely such a primary classification would be liable to lead us into error through taking insufficient account of the developments of vegetation in succession under a multitude of complex external and internal influences. Moreover, a classification on this basis would appear liable to introduce the false climax conception which Mr. Hole himself objects to as unjustifiable. For instance the continuance of grassland is probably generally due largely to grazing by wild or domestic animals, though its introduction in the first place may have been due to fire. So long as grazing continues such grassland may appear to be permanent but removal of the controlling factor will disclose the fact that it is in reality only a stage in a succession to some type of woodland. Grassland in itself is of several different types dependent on the methods of utilisation, and may form a stage or stages in more than one type of vegetation. For instance, grassland the dominants of which are *Andropogon contortus* and *Aristida* species is normally found in the Bombay Presidency in localities where climatic limitations will never allow the vegetation to develop into any higher form than thorn scrub. But excessive grazing may develop a grassland with the same dominants in a climate where, if the grazing is brought under control, grasses such as *Anthisteria ciliata* and *Andropogon pertusus* will first become dominant and finally mixed deciduous tree species will establish themselves and form woodland. Again forest management may be responsible for maintaining Broad-leaved Deciduous Woodland where discontinuance or change in management would allow Broad-leaved Evergreen Woodland to gradually develop. Some wider primary classification therefore appears to be necessary and to be most profitably sought for in a correlation of the vegetation with the site, considering the site as the cause and the vegetation only as the effect.

Dr. J. W. Toumey in his *Silviculture on an Ecological Basis* (p. 270 *et seq.*) distinguishes between *formations* and *types* and the distinction appears to be a useful one. Quoting Moss (*Succession of Plant Formations in Britain*, p. 742) he gives the definition that "the whole series of stages which began as an open or unstable vegetation, passing through the successive changes up to the stable community, is a formation." This definition might be expanded so as to make it clear that all vegetation growing on essentially similar sites forms part of one formation though supplementary factors, imposed in varying degrees upon the essential site factors, may cause the vegetation to vary greatly in floristic composition from place to place. In contrast to formations Dr. Toumey makes it clear that types may be defined on many various bases and are useful solely for descriptive purposes, whereas it is essential for the proper development of silviculture to establish the relation between forest vegetation and its environment, for which the conception of the formation is a valuable aid.

The object of this note is to suggest that primary classification should be based on essential site factors, and the term "formation" recognised as the unit, while floristic variations should be used only in subsidiary classification as far as possible. The great difficulty which has to be faced however is in labelling the different formations for purposes of description. Though it may be relatively easy to recognise different formations, it is undoubtedly difficult to describe them without referring to the vegetation which characterises them. Of essential site factors, by which is meant factors over which man can exert little or no control, rainfall and soil are the most important. But rather wide variations of rainfall produce similar vegetation and the presence or absence of vegetation develops marked differences of soil under precisely similar climatic conditions, the formation of laterite on bare sites exposed to intense rainfall and high temperature being probably an extreme example and in contrast to the podsolisation which takes place under evergreen forest on similar sites. An attempt has been made to get over this difficulty by choosing certain plants on the forest floor as indicators of site quality, but this does not seem to meet all requirements for the description of a formation, which

includes within it all developments of vegetation from tiny lichens on bare rock up to high forest. Perhaps the problem is incapable of solution until our knowledge of soil development is much greater than at present and we can fix our classification on some such base as the sum of all essential factors permitting the development of special micro-organisms. In the meantime would not a classification based on the quantity and annual distribution of rainfall be less liable to lead us into error than one based on the differences of the vegetation? The latter is only the answer to the equation which we are trying to solve, but our work must be directed towards finding out the varying sums and powers of x, y & z which produce that answer. The sort of classification which I have in mind is one which would distinguish between monsoon and perennial rain, *i.e.*, climates with or without a marked dry season, and then sub-divide each of these classes on some such basis as very heavy rainfall (over 200″) heavy rainfall (100″—200″) moderate rainfall (50″—100″), light rainfall (20″—50″), and deficient rainfall (20″ and under). These sub-divisions would of course be chosen so as to coincide, as far as our present knowledge permits, with the various distinct types of vegetation which appear to be the climax under each set of climatic conditions, thus each representing, a separate formation but avoiding the use of any special floristic distinctions in the title. By this means the error of considering only the later stages of each succession to be representative of a formation would be avoided, and the variations of site would be recognised as the controlling units of classification.

[We understand that Mr. H. G. Champion, the Central Silviculturist, is at present working on this subject in consultation with the research officers and others interested in the several provinces. We believe that his conclusions will be found to agree substantially with Mr. Garland's as to the most satisfactory basis for classification.—*Ed.*]

AUSTRALIAN SANDALWOOD.

By S. Ramaswami, Upper Grade Assistant, Minor Forest Products Section, F. R. I.

In European commerce there are three distinct classes of sandal-wood, the East Indian or genuine sandalwood from *Santalum album*

of India, the West Australian sandalwood, and the sandalwood of the Pacific group. Of these the first two are more important than the third.

India has a considerable export trade in sandalwood and sandalwood oil as shown in the following table (1) :—

QUANTITY.

	1926-27.	1927-28.	1928-29.	1929-30.	1930-31
Sandalwood in tons ..	866	993	960	943	708
Sandalwood oil in galls. ..	15,938	15,616	18,670	14,988	8,724

VALUE IN RUPEES.

	1926-27.	1927-28.	1928-29.	1929-30.	1930-31.
Sandalwood ..	14,87,624	16,21,442	17,28,121	16,33,716	11,83,743
Sandalwood oil ..	22,60,405	22,26,380	26,86,091	23,36,096	12,83,213
Total ..	37,48,029	38,47,822	44,14,212	39,69,812	24,66,956

The export figures have continued to drop both in quantity and value during recent years due to the increasing competition of Australian sandalwood in the European markets. Universal trade depression may also be partly responsible for the reduced consumption of Indian sandalwood oil in the world markets.

The quantity and value of import of sandalwood into India during the last five years are given below. They come mostly from Australia, but the Straits Settlements, Kenya, Zanzibar and Hongkong also contribute their share :—

Imports of Sandalwood into India.

	1926-27.	1927-28.	1928-29.	1929-30.	1930-31.
Quantity in tons ..	412	428	553	486	340
Value in Rupees ..	2,19,238	2,09,436	2,42,465	2,78,292	1,36,451

Australian sandalwood costs roughly one-fourth the price of genuine Indian sandalwood and recently Australian sandalwood oil has attained the distinction of being included in the British Pharmacopœia (1932) ([8]) from which it has previously been excluded. The future of the Indian sandalwood trade is therefore not too bright, when these two considerations are taken into account. It should, however, be made clear that it is only the *commercial oil* from Australia which is included in the British Pharmacopœia (1932), and as will be shown later this oil is really a mixture, which, though passing the minimum standard required in the Pharmacopœia does not by any means possess all the qualities of the genuine article.

Australian manufacturers have been making persistent attempts to improve the quality of commercial Australian sandalwood oil so that its physical constants may approximate to that of the genuine Indian oil, and they have succeeded so well in their attempts that, as stated above, Australian sandalwood oil has now been included among the official drugs in the 1932 revision of the British Pharmacopœia which is to be published very shortly. This will undoubtedly give an impetus to the Australian oil which is much cheaper than the Indian oil, and the export trade of the latter will probably suffer in consequence.

What is Australian sandalwood ? Eminent botanists are not in agreement as to the exact systematic position of the plant from which it is derived. Australian sandalwood, or more correctly, West Australian sandalwood is known under the following names :—

Fusanus spicatus, R. Br., *Santalum spicatum*, A. DC., *Eucaria spicata*, R. Br., *Santalum cygnorum*, Miq., and *Mida cygnorum*, Kuntze.

The West Australian Forestry Department in 1927 approached the Royal Botanical Gardens, Kew, to clarify the position as regards the nomenclature. Sprague and Summerhayes ([2]) who conducted this investigation suggest that the West Australian sandalwood tree should be called *Eucaria spicata*, R. Br.

More recently C. A. Gardner, ([3]) Government Botanist, West Australia, who has made a thorough examination of *Eucaria spicata* (syn. *Fusanus spicatus*) and of various species of *Santalum* concludes that *Fusanus* is undoubtedly cogeneric with *Santalum*. He says that "the confusion in nomenclature in the past must be largely attributed to Bentham and Hooker in adopting the lobing of the disc as an important generic character for merely one section of the *Osyrideae*. It is suggested that some more fundamental point, such as the placentation of the ovules, as taken up by De Candolle, might be given due prominence in a future discussion of the tribe in question. *Fusanus* cannot be separated from *Santalum* on any character that may be regarded as generic when regarding *Santalaceae* as a whole. In several other genera the distinctions which separate *Fusanus* are of no more than specific importance." According to Gardner, therefore, the West Australian sandalwood is *Fusanus spicatus*, R. Br.

A large proportion of the sandalwood exported during the past 80 years from Australia has been obtained from agricultural land which is now under wheat. According to the classification of the timber-lands of the State made by the Forest Department, sandalwood has 330,000 acres out of which 278,442 acres carry a good stocking of host plants and have a sufficient natural regrowth of sandalwood to justify reservation and demarcation without further artificial regeneration. 7,744 acres have been fenced against cattle and 2,659 acres have been rabbit netted for experimental sowing. But the results of artificial regeneration are not very satisfactory. ([11]).

The following table shows the progress made by Australia in the export trade of sandalwood and essential oils, principally sandalwood oil. Separate figures for the latter are not available: ([11]) and ([12]).

Period.	Annual Average for the Period.		
	Sandalwood.		Essential oils, principally sandalwood oil.
	Tons.	£	£
1901—1910	7,195	55,971	Nil.
1911—1920	7,276	83,289	1,523
1921 -1929	7,753	187,285	32,856

The export of sandalwood does not show any marked increase in quantity, but its value has enormously increased. A large quantity of the wood is distilled in Australia itself and its physical constants are brought up to the requirements of various Pharmacopœias by a number of processes as will be described below.

The yield of oil from West Australian sandalwood varies from 2 to 3 per cent. as compared with a yield of 5 to 6 per cent. from *Santalum album* ([4]).

Two samples of West Australian sandalwood oil were analysed at the Imperial Institute in 1920 ([9]). It is clear from the results there that the alcohol content of this oil (calculated as santalol, $C_{15}H_{24}O$) falls below that required by the different Pharmacopœias for genuine sandalwood oil, *viz.*, 90 per cent. Although it is very easy by

fractional distillation of the Australian oil to obtain a product containing more than 90 per cent. of alcohols calculated as santalols, the alcohols present in it are not identical with either of the two santalols present in the East Indian (genuine) sandalwood oil, but are isomeric with them.

A. R. Penfold in a paper read before the Royal Society of New South Wales on 6th June 1928 says that 40 to 45 per cent. of santalol was found in a *commercial* sample of West Australian sandalwood oil analysed by him, but that he found no santalol in oil distilled by himself from the wood. The oil obtained from *Santalum album* contains from 90 to 96 per cent. of santalol.

West Australian oil, as distilled from the wood, does not pass the British, American and Japanese Pharmacopœia solubility tests, but by eliminating some of the lower boiling constituents, it is possible to obtain an oil passing these solubility tests, and this is actually being done now.

The chief difficulty in introducing West Australian oil as a substitute for the genuine East Indian oil is the difference in the optical rotation between the two oils. The official requirements of different Pharmacopœias on this point are :—

		Op. rotation.
B. P. (1914)	..	.. 13° to—21° at 20°.
Am. P. (1914)	..	.. 15° to—20° at 25°.
Jap. P. (1920)	..	.. 15° to—20°.

The values for various samples of West Australian oil do not approximate to these requirements. The oil of *Santalum lanceolatum* found in Australia contains a laevorotatory alcohol with a specific rotation of—70·4°, and this is mixed in suitable proportions with the West Australian sandalwood oil to bring its optical rotation within the limits prescribed by the Pharmacopœias.

Venkatesaiya and Watson[10] of the Indian Institute of Science, Bangalore, observe that in spite of the blending of the two oils of *Eucarya spicata* and *Santalum lanceolatum* the specific gravity of the mixture does not come up to the normal density of genuine sandalwood oil from *Santalum album*.

For perfumery purposes West Australian oil is, therefore, not so good as the East Indian oil. Those who have been using this oil for years state that they have never found it equal in quality to the genuine East Indian oil and have consequently confined its employment to second quality soaps and perfumes ([5].)

Medical practitioners in Australia claim that medicinally West Australian oil is as good as the genuine (East Indian) oil ([6]). Dr. Fr. Boedecker and Dr. Heinz Ludwig ([7]), on the other hand, found that the West Australian oil, as compared with the East Indian, possessed no experimentally demonstrable antiphlogistic properties and that its use as a substitute for true sandalwood oil was, therefore, inadmissible.

SUMMARY.

West Australian sandalwood oil is obtained from a species which is named by the Kew authorities as *Eucarya spicata*, R. Br.

" Commercial " West Australian oil is a mixture of the oils of *Eucaria spicata* and *Santalum lanceolatum*.

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TEPHROSIA CANDIDA EXPERIMENTS IN CENTRAL PROVINCES.

By Tara Singh, I.F.S.

In the Demonstration Area, Betul, several species were planted out during 1930 in pits or ditches prepared to about 12″ to 18″ depth, and *Tephrosia candida* seed was sown all round. The latter grew splendidly and proved an excellent *nurse*, protecting very successfully every single plant growing under its cover throughout the very dry summers, with little or no watering. The plants developed vigorously with its help and in certain cases overtopped it in the second season. The height growth put on by some species in two years may be of general interest :—

Species.	Height (inches). Maximum.	Average.
Bija	4	..
Chir pine	6	2
Teak	18	..
Bamboo	30	18
Sandal	56	44
Jacaranda	103	62

2. *Tephrosia* was pruned according to need where it was grown with forest plants : thus it protected effectively the tiny forest plants from the drying effects of the direct sun during the two summers (with maximum temperature 108°-112° F.) and allowed them to grow freely during rains while screening them successfully from the strong monsoon winds.

3. *Tephrosia* sown at Betul in the Silviculturist's compound as a hedge during July 1930, continued to grow vigorously, in height and laterally, attaining a maximum height of about 6-7 feet in about 15 months after sowing. The plant flowered profusely during July-August 1931 (*i.e.*, during second season), displaying creamy-white scented racemes. Pods were collected in October-November just before they could split open and were dried before taking out the fertile seed. *Tephrosia* has continued to flourish even after seeding and the plants

have reached an average height of 8 feet and a maximum of $8\frac{1}{2}$ feet by the middle of August 1932.

4. *Tephrosia candida* has proved an effective and excellent nurse since its introduction in the Central Provinces by the Silviculturist in 1930, and its use in the forest plantations (where it should be sown in intermediate lines, preferably running north to south) is hence strongly recommended.

5. There is no fear of its getting out of control like *Lantana*, as it can be very easily eradicated : it is very susceptible to water-logging and browsing and sensitive to white ants : cattle also devour it readily. The advantages of *Tephrosia* lines are obvious : protection from the sun, providing of side-shade, amelioration of the soil and suppression of useless weed-growth besides being a soil covering to minimise drought and frost dangers.

6. *Tephrosia* sown at Balaghat has been growing vigorously with the advent of the monsoon (recording 50″ rainfall), but during July and August a fairly large number of seedlings have wilted and died. Plants of $4\frac{1}{2}$ feet height have even been affected in intermittent or continuous hedge sections. The wilting of otherwise healthy seedlings commences from the top and at the same time a brownish discolouration advances from the ground level upward along the main stem. The foliage turns yellow and withers within a week. The diseased specimens sent to the Government Mycologist, Central Provinces, Nagpur (Agriculture Department), reveal the presence of a fungus, a *Pithium*, possibly *P. de Baryanum*, in the plant tissue. The Central Silviculturist, Forest Research Institute, Dehra Dun, informs me that he has never seen anything like this in other provinces except occasional cockchafer attacks at the roots and adds that it is unusual to experience wilting with such large and semi-woody plants. According to his recommendation, the Bordeaux Mixture (2-2-50) prepared locally from blue stone or crystalline copper sulphate (*morchu*), quick lime (*chuna-khadi*) and water as suggested by the Mycologist, Central Provinces, is being applied to a few diseased hedge sections. The results of this and other similar treatments will be watched with interest.

RELATION BETWEEN FIRE AND CLIMBERS IN SAL FOREST.

BY R. N. DE, I. F. S.

Assam foresters are generally agreed about the efficacy of fire as an instrument for regeneration of *sal* forests in Assam, and their conclusions are based on observations made in the *zamindari* forests. Fire has been sweeping through the *zamindari* forests for a very long time and no attempt has been made by the proprietors of these forests to protect them against fire. This is not due to any great interest in the regeneration of their *sal* forests, but to indifference. The effect of annual fire on their *sal* forests can be seen in the beautiful natural regeneration that is taking place everywhere in the midst of the thatch grass which is the usual undergrowth of the *sal* forests burnt over annually. Of course, the fire is also responsible for the unsoundness of many trees and reduction in quality class.

It has been stated by Milroy [1] that fire keeps down the creepers, and Bor [2] says that in burnt areas saplings are free from creepers.

The expression "creeper" has apparently been used by both to include creepers and climbers which have since been separately defined. In this note, the latest definitions have been adopted, namely—

Creeper.—A plant which runs along the ground and produces roots at intervals. A common misnomer for a climber.

Climber.—A general term including climbing plants that ascend upon a support by twining, by means of tendrils, hooks, aerial roots or other attachments.

Let us now examine the incidence of creepers and climbers in burnt areas. Going through the *zamindari* forests adjoining the Government forests of Goalpara Division, even by road or train, one cannot but notice large tangled masses of climbers and the luxuriant undergrowth of thatch. These *sal* forests in the *zamindari* land have been burnt for a very long time and indeed it is doubtful whether they were ever fire protected, but climbers are found in large numbers all over the forests.

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[1] A. J. W. Milroy—"Indian Forester," October, 1930. Relation between *sal* forests and fire.

[2] N. L. Bor—Working Plan of Goalpara Forest Division, 1929—30 to 1938—39.

The existence of these climbers then cannot be explained by the hypothesis stated before, *viz.*, that fire keeps down creepers.

On examination of the wet type of *sal* forest which fire does not burn or burns indifferently, one finds that there is an abundance of evergreen creepers and climbers, *e.g.*, *Ipomea*, *Piper*, *Entada*, *Gouania*, *Aspidopteris*, *Marsdenia*, *Smilax*, *Toddalia*, *Ventilago*, etc., and in some cases the ground is matted with them. These are conspicuous by their absence in the fire-burnt *sal* forests where thatch takes the place of evergreen creepers and *sau* (*Pollinia*) and other kinds of grasses.

In the fire-burnt *sal* forests, the most frequent and common climbers met with are *Spatholobus roxburghii*, *Milletia auriculata*, *Acacia pennata*, *Vitis latifolia*, *Dalbergia stipulacea*, etc. They are not only deciduous but fire resisting, and some of them have attained huge dimensions. One *Spatholobus roxburghii* climber measured recently by the writer in the fire-burnt *sal* forests of Bhutan was found to be over 7 feet in girth at breast height! Instances have been noticed in which a dead *sal* tree was burnt more than half way through by fire, but a *Vitis latifolia* twining round it escaped injury completely. It is true that *Milletia*, *Acacia*, etc., do occasionally get burnt down to the ground by fire, but they coppice vigorously, so are none the worse for fire and behave exactly in the same way as *sal* saplings.

From what is recorded above one feels inclined to conclude that fire has no serious effect whatever on the deciduous climbers although it does keep down the evergreens and that frequent climber cutting is the only remedy that will keep the former down. It also appears to the writer that the unrestricted grazing of cattle and buffaloes in the *zamindari* forests must also be responsible in a large measure for keeping down the evergreen creepers and climbers in those forests.

SPRUCE RED WOOD.

BY K. L. AGGARWAL, I. F. S.

In an article in the *Indian Forester* for May 1919, Mr. Glover dealt with the difficulties of extracting red-wood sleepers of spruce (*Picea morinda*), as the same would not float. He also carried out preliminary

tests in drying and water absorption by both red and white wood. These tests showed that both these woods after drying for $6\frac{1}{2}$ months absorbed equal quantities of water, *e.g.*, 252 ounces per cubic foot in two months. The experiments carried out in floating red-wood spruce, however, were reported to have yielded negative results and it was still a matter for decision whether red sleepers would absorb water too rapidly for them to reach the depots. The assistance of the Forest Research Institute, Dehra Dun, was also sought and the experiments regarding water absorbing capacity of the specimens supplied by Upper Bashahr Division gave encouraging results. In the September issue of the *Indian Forester* for the same year the results of these experiments were summarised by Mr. A. Hafiz Khan, Assistant to the Forest Botanist, as follows:—"that the red wood is heavier, volume for volume, than the normal white wood, but after soaking both the specimens in water for the same length of time the white wood becomes much heavier, volume for volume, than the dark wood; hence the water absorbing capacity of the red wood is, in fact, less than that of the normal white wood."

In the light of these experiments it was hoped that local officers would undertake some further experiments on a larger scale with the object of definitely testing the truth or otherwise of the local belief that the red wood does not float. It seems, however, that the matter rested there, and as no experiments on a larger scale were undertaken, the wastage in conversion in spruce forests continued to be enormous. Nothing seemed to be wanting except this floating experiment since even the results of investigations into the relative strengths of the two woods carried out at the Forest Research Institute, Dehra Dun, conclusively established that in spike holding power, strength, stiffness, toughness and hardness spruce red wood is superior to spruce white wood. These results were published in the *Indian Forester* for January 1922 and thereby proved the fitness or rather the superiority of red wood for railway sleepers.

With a view therefore of testing whether red wood spruce sleepers would float or not, an experiment was carried out last year in the Seraj Forest Division by the writer. For this purpose 250 red wood

sleepers were converted during October-November 1930, and were stacked under shade up to the end of August 1931. They were stacked with cross-pieces, under shade to prevent ends from cracking, and were allowed to be air dried up to the end of August 1931, when they were launched with the *ghal* in the Kurpan Gad. To distinguish them at the sales depot these sleepers were engraved with a special mark. It may also be noted that the sleepers had 19 miles of nullah floating which alone took 2½ months besides another 1½ months to reach the boom so that they remained in water for almost 4 months. This is about the maximum time which timber ordinarily takes to reach the boom from the hill divisions in any one year. It was found that as many as 243 out of the above 250 sleepers reached the Doraha depot, *i.e.*, a receipt of 97·2 per cent. This percentage of receipts is actually higher than the receipt of white wood sleepers and nearly as much as for deodar which was 97 per cent thus establishing the fact that properly dried spruce red wood can be floated as easily as any other timber. The Chief Conservator of Forests, Punjab and N. W.-F. Province, accordingly noted as follows on the results being communicated to him :—

> "This shows that one can use red wood of spruce perfectly well and orders to this effect should issue to divisions."

The main thing on which stress must be laid is that timber so converted must be air dried for a sufficiently long time, *i.e.*, for a period of 8-10 months at least. It should thus be possible in future to convert the red logs which used to be left unconverted in the forest.

ELEMENTS OF FOREST MENSURATION.

BY H. H. CHAPMAN and D. B. DEMERITT.

J. B. Lyon Co., Albany, New York, 1932. *Price* 4·50 *dollars*.

The book is aptly dedicated to the late Professor J. W. Toumey whose death on 6th May 1932 deprived the Yale Forestry School, and the American forestry movement as a whole, of a notable leader, whose practical outlook combined with a wide scientific knowledge had done much to promote a sound forest sense in the United States.

The present volume is a decided improvement on Chapman's " Forest Mensuration " of 1921 in so far as it emphasises the need for an *economic* approach to forest measurement problems. His classification of methods is now based upon permissible costs :—

" Too much money can easily be spent on obtaining an accurate estimate of standing timber of low value. Costs which exceed 1 per cent. of the stumpage value of the timber may be considered high." This is a point which might well have been considered in some recent Indian working plans before embarking upon too elaborate enumerations.

The arrangement of the various sections is claimed to be an improvement on previous text-books, and is certainly more logical in that it deals fully with the measurement and estimate of volume at the various stages of exploitation before grappling with increment and yield figures. A new departure is a chapter on the reliability of aver-

ages which deals very clearly and fully with the mathematics of probable error and standard deviation. with practical examples of their application.

Another change is the introduction into volume table construction of the "alignment chart" on the principle of the slide rule. Two independent variables, say height and diameter, are scaled out on the opposite sides of a squared-paper chart, and a scale prepared between them will give the product, in this case a volume figure, by drawing a straight line between the two outer scales. This method is being extensively employed in the United States Forest Department practice.

The chapters on age and height growth, current increment and the construction of yield tables are better arranged and more clearly dealt with than in the previous book, and it can be recommended to all those immediately concerned with the teaching of forestry students or with the statistical side of jungle work.

R. M. G.

ENTOMOLOGICAL INVESTIGATIONS ON THE SPIKE DISEASE OF SANDAL, PART I.—AN INTRODUCTORY SURVEY OF THE PROBLEM.

By Cedric Dover (Ind. For. Rec. Vol. XVII, Part I, Entom. Series).

Following upon the publication in our September number of the proceedings of the 7th Spike Conference and a reference to the importance of the problem in our editorial in the same issue, we welcome the appearance of this record, which gives a detailed and most interesting account of the entomological side of the question. A general survey of the insect-fauna of sandal at North Salem and Coorg was made by Dr. Beeson and Mr. N. C. Chatterjee and the bulk of this record is a detailed analysis of the material collected in this way, particularly of the various types of suctorial flies and aphids which are under suspicion of acting as vectors of some virus.

HOME FORESTRY PERIODICALS.

Forestry, the Journal of the Society of Foresters of Great Britain, has succeeded in a short time in establishing for itself a really high reputation amongst the more technical forestry journals. When the new Society was started in 1926, it was felt by many of the older members of both the Scottish and English Forestry Societies that their journals would suffer from the competition of another forestry magazine, but this has proved not to be the case, and forestry literature has instead been enriched by many papers which would probably have been considered too advanced for the working foresters who form the bulk of the readers of the older publications. Although *Forestry* is essentially for workers in Britain, much of the contents of the present number (Volume VI, Part I, June 1932) is of interest to foresters in India, as it contains R. S. Pearson's presidential address, several papers on recent research work on plant nutrition and wood preservation which should be of wide interest, and several book reviews including an appreciation of H. G. Champion's work in the production of his two-volume *Silvicultural Research Manual for Use in India.*

The *Quarterly Journal of Forestry* contains much of interest to those who know the difficulties and uncertainties of home forestry, and a few items of wider implications. W. Dallimore has an excellent paper on the choice of small trees suitable for use in small gardens and the lesson might be extended to India where so often one finds a bungalow compound chock-a-block with unsuitable trees. There is also a very practical paper on the protection of tree wounds by A. D. C. Le Sueur who enumerates the uses of paints and varnishes, tar, asphalt, waterglass and proprietary preparations such as "Rufmat," "Solignum," etc., many of which are most useful in tree doctoring. This does not of course fall within the strict limits of forest operations but the ordinary forest man is very frequently called upon for help or advice in the saving of favourite trees, and a few practical tips of the sort are always of use in saving one's reputation amongst friends!

The current number of the *Scottish Forestry Journal* contains a most interesting account by M. L. Anderson of the preliminary stages of his work on the various races of European larch from which he

hopes to obtain valuable data on the subject of hybrid races. As the so-called "Dunkeld hybrid" (European x Japanese parents) is immune to the larch canker and has already proved a practical proposition to replace the more vulnerable European larch, the evolution of further local races is full of interesting possibilities. The prolific reproduction of individual trees is shown from the figure of 80,000 plants grown from one harvest of cones from eight larch trees. A very fully illustrated article on the biology of a willow-boring wood-wasp and its ichneumonid parasite, and a short note on the possible use of disease as a factor in controlling the bracken fern, both show how much modern methods of protection are evolving along biological lines.

R. M. G.

THE EFFECT OF LENGTH OF DAYLIGHT UPON ANIMAL AND PLANT DEVELOPMENT.

In an exceedingly interesting paper on the migration of birds in the *Journal of Bombay Natural History Society* of July 1932 (Vol. XXXV, Part 4) Whistler summarises all the known data about migration including the evidence of the detailed experiments which have been made upon the effect of light on the reproductive organs of birds. " What is the nature of the stimulus that starts the bird off ? Various factors have been pressed into service by different writers, of which food supply and temperature seem *prima facie* the most likely. But all suggested factors are variable in their incidence while regularity is a basic characteristic of migration. There is therefore much that is attractive about Professor Rowan's recent suggestion that the explanation of the regular rhythm is to be found in day length. Day length is now recognised as of vital importance to all creatures whose activities are directly or indirectly influenced by sunlight. Professor Rowan claims to have established that the reproductive organs of a bird are directly affected by day length. By artificially manipulating the amount of daylight to which a bird is exposed, the interstitial tissue of the reproductive organs may be brought into any desired stage of development. It can be advanced or retarded as compared with other individuals of the species subject to normal conditions. The hormone produced by this tissue controls sexual behaviour and migration can, therefore, be considered as a definite phase of reproduction, linked to it.

Professor Rowan's experiments also produced valuable circumstantial evidence. On the one hand he kept migratory species under normal conditions until winter and then released them after the tissue changes were complete. These birds did not migrate as the stimulus had then apparently passed. Other birds were kept until mid-winter under artificial conditions of light sufficient to produce a premature increase in the tissues, equivalent to that of the spring season. These birds when liberated in mid-winter disappeared at once and some of them were actually recorded as moving northwards, that is in the direction of the spring migration.

The explanation of migration suggested by these experiments is then as follows. The rhythm of the waxing and waning of the year, working through quantity of daylight hours, which control physical activity, induces a corresponding rhythm in the reproductive system."

A similar insistence upon the importance of length of daylight to plant growth is upheld by Allard in *Ecology*, XIII, Part. 3 for July 1932 in an article entitled "Length of Day in Relation to the Natural and Artificial Distribution of Plants." Dealing with the effect of daylight from the point of view of invasive plants, he groups the flowering of all plants into one of three divisions, namely short-day plants such as poinsettia and chrysanthemum, long-day plants such as most of the garden annuals and alpines, and a third indeterminate group which flowers independent of the length of daylight. A typical long-day plant when introduced from a northern temperate climate to a semitropic one will often fail to flower and remain strictly vegetative. Controlled illumination of garden species of *Sedum* (stone-crop) proved that an 18-hours' illumination advanced flowering by more than a week compared with a 16-hour day and that flowering was definitely inhibited with anything less than a 13½-hour day. Such a plant could not be expected to extend in anything approaching tropical conditions. On the other hand many tropical plants introduced in northern climates do not flower readily until the span of daylight is reduced below 13 hours, and in some even vegetative growth appears to be retarded by very long daylight. Thus the only potentially cosmopolitan plants must come from amongst the group of indeterminate flowerers which can persist in both high and low latitudes. Sensitiviness to frost is not necessarily a hindrance if flowering and fruiting can be completed in the short mid-summer climate of the north, but frost-sensitive plants with greatly restricted requirements for short days of less than 12 hours must confine themselves to the tropics.

"A proper recognition of the length-of-day requirements of plants makes possible a clearer interpretation of many aspects of their behaviour and natural distribution than we have had heretofore. In our artificial introductions, this factor must be taken into account,

especially where flowering and fruiting appears to be disturbed. The entire matter may depend upon maladjustments in this direction which have been overlooked. It is unquestionably true that man for ages has unconsciously selected for better seasonal adjustments, and in these activities all his early and late varieties for northern or southern regions reflect in greater or less degree relationships with the ubiquitous length-of-day factor in one way or another. Until strains are found with much wider day-length requirements, many promising tropical plants must be confined to the tropics, however useful they may be."

R. M. G.

EXTRACTS.

SALUTE TO THE TREES.

By Henry Van Dyke.

Many a tree is found in the wood
And every tree for its use is good:
Some for the strength of the gnarled root,
Some for the sweetness of flower or fruit;
Some for shelter against the storm,
And some to keep the hearth-stone warm;
Some for the roof, and some for the beam,
And some for a boat to breast the stream;—
In the wealth of the wood since the world began
The trees have offered their gifts to man.

But the glory of trees is more than their gifts:
'Tis a beautiful wonder of life that lifts,
From a wrinkled seed in an earth-bound clod,
A column, an arch in the temple of God,
A pillar of power, a dome of delight,
A shrine of song, and a joy of sight!
Their roots are the nurses of rivers in birth;
Their leaves are alive with the breath of the earth;
They shelter the dwellings of man; and they bend
O'er his grave with the look of a loving friend.

I have camped in the whispering forest of pines,
I have slept in the shadow of olives and vines;
In the knees of an oak, at the foot of a palm
I have found good rest and slumber's balm.
And now, when the morning gilds the boughs
Of the vaulted elm at the door of my house,
I open the window and make salute:
"God bless thy branches and feed thy root!
Thou hast lived before, live after me,
Thou ancient, friendly, faithful tree."

(*Scribner's Magazine*, May 1921).

REPORT OF THE INDIAN TRADE COMMISSIONER FOR 1931-32.

CHAPTER II.—INDIAN TIMBER.

Written by H. S. Tireman, C.I.E., Timber Adviser to the High Commissioner for India.

GOVERNMENT SALES.

The position in the hardwood market throughout the year continued extremely difficult. It was impossible to interest Continental buyers even at cheap rates, and although there appeared at the end of the year to be a slightly better undertone in the Home market, buyers were inclined to restrict purchases to their immediate requirements. At the same time, since Great Britain went off the gold standard there has been an increasing tendency to favour Empire woods, which has been accentuated by the imposition of the tariff. This affected the Indian trade more especially in the matter of flooring woods, and a sudden demand sprang up for this class of timber in the autumn, the whole output of gurjan flooring from the Andamans up to June 1932, being sold in a short time. Considerably larger quantities could have been sold had they been available. A further result of the "Buy Imperially" movement was the sale of some 110 loads of Andaman padauk and 28 loads of koko; no sales of these timbers had taken place for upwards of two years.

There was a decline in the quantities and values of Indian Government timber delivered during the year as compared with 1930-31, the quantities falling from 1,405 to 799 tons, and the values f.o.b. Indian port from £11,700 to £6,900. All but 9 tons (from Burma) was shipped from the Andaman Islands. Fortunately, we were able to offset this decline in respect of timber proper by a shipment of sandalwood valued at about £3,000 f.o.b. Indian port, which was far in excess of last year's shipments (aggregating £500 only). There is some justification for holding that this sale was instrumental in stimulating competition at the sandalwood auctions held in South India early in 1932, where the prices obtained showed a large advance over those of recent years.

Including sandalwood, the value (f.o.b. Indian port) of deliveries was thus £9,900, as against £12,200 during the previous year. The decline in the deliveries of timber was due to the falling off in sales during the previous two years caused by the general trade depression. While optimism is as yet scarcely justified, it is of interest to note that the quantity of timber due for delivery during the current year (1932-33) has already attained a volume of 685 tons valued at £6,500 f.o.b. Indian port. If further orders are received to the same extent during the remaining eight months of the current year, the results should show a considerable improvement over those obtained during the past year.

In respect of sales negotiated during the year under report, while the volume of business fell from 1,209 tons to 778 tons and the f.o.b. value from £14,630 to £6,764, the number of sales increased from 15 to 26, a fact which would tend to show that the interest of a wider field of buyers is being attracted.

COMMERCIAL ENQUIRIES.

Apart from those which resulted in sales, the number of enquiries received from potential buyers was 20, the quantity of timber to which they related being some 1,100 tons; 8 enquiries were also received for unspecified quantities of timber.

Some 25 enquiries of a general character were received for information on the following subjects :—

The kinds and quantities of timber available for export.

The possibility of using white mahogany, white bombwe, white chuglam, and Indian balsa for motor-car bodies.

Timbers suitable for flooring.

The availability of laurel and koko for the manufacture of veneers in Australia.

Hardwoods suitable for the manufacture of furniture in Canada.

The possibility of and the necessary procedure for selling privately owned Indian timber in Great Britain and Germany.

The quality of teak supplied under various trade marks.

The best methods for testing a new wood preserving preparation in the tropics.

Where certain Indian timbers can be obtained in this country.

Wood suitable for brushes for the Indian Army.

The qualities of pyinkado for flooring.

Timbers suitable for staining for exhibition purposes.

Timbers suitable for the decoration of railway coaches in this country.

Pyinkado sleepers for Palestine.

The suitability of silver-grey for a new post office building.

The possibility of obtaining a forest concession in the Andamans or Madras.

Whether gurjan flooring strips can be supplied tongued or grooved.

Several requests were also received and complied with for timber specimens for instructional purposes.

The enquiry referred to in last year's report regarding the possibility of supplying railway keys for use in this country led to no result, the prices quoted being uneconomical. The enquiry from Italy referred to in the same report has resulted in some sample squares being sent from the Andamans to Trieste.

Efforts were again made at the instance of the Chief Conservator of Forests, Madras, to interest firms in sandalwood, but no business resulted. Sales of this wood were, however, effected, on behalf of Coorg.

EMPIRE MARKETING BOARD.

The investigation of timbers suitable for turnery was completed, and an interesting pamphlet on this subject was published by the Board. The Indian woods experimented with were classified as follows :—

Suitable for ornamental turning :—

Class 1.—Burma blackwood and Andaman bulletwood.

Class 2.—Coromandelwood, anjan, soymida, Indian boxwood, Indian olive.

Class 3.—Cassia siamea, rosewood, Burma tulipwood, sissoo, Andaman marblewood, piney, mesua, thinwin, Andaman satinwood, sandan, Andaman padauk, Indian laurel and pyinkado.

Suitable for plain turning :—

Class 1.—Cassia siamea, rosewood, Burma tulipwood, anjan, thinwin, Andaman bulletwood, Indian olive.

Class 2.—Burma blackwood, Coromandelwood, Andaman marblewood, soymida, Indian boxwood, Andaman satinwood.

Class 3.—Sissoo, piney, mesua, sandan, Andaman padauk, Indian laurel, and pyinkado.

[The botanical names of the above woods are as follows :—

Burma blackwood	=	*Dalbergia cultrata.*
Andaman bulletwood	=	*Mimusops littoralis.*
Coromandelwood	=	*Diospyros melanoxylon.*
Anjan	=	*Hardwickia binata.*
Soymida	=	*Soymida febrifuga.*
Indian boxwood	=	*Gardenia latifolia.*
Indian olive	=	*Olea ferruginea.*
Rosewood	=	*Dalbergia latifolia.*
Burma tulipwood	=	*Dalbergia oliveri.*
Sissoo	=	*Dalbergia sissoo.*
Andaman marblewood	=	*Diospyros marinorata.*
Piney	=	*Hardwickia pinnata.*
Mesua	=	*Mesua ferrea.*
Thinwin	=	*Millettia pendula.*
Andaman satinwood	=	*Murraya exotica.*
Sandan	=	*Ougeinia dalbergioides.*
Andaman padauk	=	*Pterocarpus dalbergioides.*
Indian laurel	=	*Terminalia tomentosa.*
Pyinkado	=	*Xylia dolabriformis.*

ED.]

The enquiry into the suitability of Indian grown Honduras mahogany for the United Kingdom markets is not yet complete, but preliminary reports are extremely favourable.

PUBLICITY AND PROPAGANDA.

The Timber Adviser attended the Congrés International du Bois et de la Silviculture at the Paris Colonial Exhibition. The rapid progress made in recent years in introducing to popular favour in France the timbers of the French tropical colonies was strikingly demonstrated at the Exhibition.

The Timber Adviser also visited Amsterdam in connection with deliveries of trial quantities of gurjan, Andaman padauk, white mahogany, and white bembwe, which have been consigned to Holland for sale on commission, and went on to Hamburg where he interviewed a large number of firms in conjunction with the Indian Trade Commissioner, Mr. S. N. Gupta, I.C.S., with a view to pushing the sale of Indian timbers. Conditions in Germany, however, are the reverse of favourable at present and until a considerable improvement takes place there does not appear to be a market for Indian timbers there.

COMMITTEES.

The Timber Adviser is a member of the following technical committees relating to Forestry and Forestry Products on the nominaton of the High Commissioner for India :—

The Empire Timbers Committee of the Forest Products Research Board of the Department of Scientific and Industrial Research ;

The Imperial Institute Advisory Committee on Timber ;

The Imperial Institute Advisory Committee on Tanning materials ;

The Governing Council of the Empire Forestry Association.

He is also a member of the Timber Trades Federation of the United Kingdom and an Associate Member of the British Wood Preservation Assocation.

PREMATURE GERMINATION OF FOREST TREE SEED DURING NATURAL STORAGE IN DUFF.

For some years forest investigators in the Pacific North-west have been aware of the considerable quantity of tree seed which accumulates in the duff of heavy virgin timber stands and apparently retains its vitality for a few years in a so rtof natural cold-storage condition. The major portion of the luxuriant regeneration which frequently follows logging and forest fires in the western white pine forest of northern Idaho has, in fact, been attributed by many foresters to this stored seed. The theory is that wholesale germination is stimulated by removal of the dense overwood shade and consequent raising of temperature of the cold and damp storage medium.

The amount of viable seed in the duff in relation to the time elapsed since the last seed crop has, however, never been accurately determined. As an answer to this question is essential to any proper understanding of the role played by stored seed in the regeneration of burned and cutover areas, the Northern Rocky Mountain Forest Experiment Station has been conducting a series of tests in which seed is stored under natural conditions for periods up to eight years in length to see how long and how much seed will remain viable.

One very interesting fact brought out to date by recent storage experiments is that a certain amount of stored seed is lost by premature germination. For some unknown reason, some seed germinates preceding any disturbance or opening up of the overwood canopy. The accompanying photograph (not reproduced) shows seed that germinated under the dense shade of an overmature mixed stand of western white pine (*Pinus monticola*), western hemlock (*Tsuga heterophylla*), lowland white fir (*Abies grandis*), Douglas fir (*Pseudo-tsuga taxifolia*), and western larch (*Larix occidentalis*) during two years of storage in the raw humus characteristic of such stands. Most of this germination took place during the second season of storage, less than one per cent. germinating in this manner during the first season. As the resulting seedlings promptly died, due to unfavourable light and moisture conditions created by the presence of the overwood stand, seeds germinating in this manner are wasted as far as future regeneration of the area is concerned. As about one-third of the viable seed originally stored in the tests described has germinated and died in this manner in the first two years of storage, it is evident that this premature germination is one of the factors which determine how long and how much of the seed of any one crop of western pine cones will remain dormant in the duff until the removal of the overwood stand and hence be available in regenerating the area.

Northern Rocky Mountain Forest and Range Experiment Station, U. S. Forest Service. — I. T. HAIG,

(*Ecology, July* 1932).

TIMBER USED IN CARRIAGE AND WAGON SHOPS IN INDIA DURING 1931-32.

Analysis of returns showing quantities of various timbers used.

Item No.	Trade Name.	Botanical Name.	Quantity Tons, log 1929-30.	Quantity Tons, log 1930-31.	**Quantity Tons, log 1931-32.**	REMARKS.
1	Teak (Burma) ..	Tectona grandis ..	28,292	21,500	**11,563**	Recommended that a proportion of high class squares should be purchased and kept separate for bottom sides only. For other purposes a trial of log ends is suggested. Scantlings are available at favourable rates in Bombay and Calcutta.
2	Teak (Indian) ..	Do. ..	5,289	3,842	**3,599**	Carriage constructed in 1928 of C.P. teak reported satisfactory.
3	Sal ..	Shorea robusta ..	3,092	1,315	**2,075**	
4	Deodar ..	Cedrus deodara ..	1,940	2,150	**1,251**	
5	Padauk (Andaman)	Pterocarpus dalbergioides.	1,379	1,611	**537**	The Chief Forest Officer, Andamans, quotes squares at Rs. 120 per ton c.i.f. Calcutta or Madras.
	,, (Burma) ..	Pterocarpus macrocarpus	..	..	**25**	
6	*Bonsum ..	Phoebe hainesiana ..	500	356	**25**	Often marketted as Assam teak. It is not teak and should be ordered as bonsum.
7	Maiyang or eng ..	Dipterocarpus tuberculatus	433	1,339	**1,398**	Maiyang is the Siamese name for the timber called eng in Burma.
7*a*	*Hollong ..	Dipterocarpus pilosus	..	..	**427**	
8	*Gurjan ..	Dipterocarpus turbinatus and allied species.	348	652	**37**	Similar to eng or maiyang and sometimes substituted. *The Chief Forest Officer*, Andamans, quotes machine sawn bottom boards at Rs. 100 per ton and squares at Rs. 65 per ton.
9	*Haldu ..	Adina cordifolia ..	515	866	**1,015**	
10	Jaman ..	Eugenia jambolana	..	405	**399**	Also called nerale. Used for bottom boards.
11	Poon ..	Calophyllum species	142	562	**315**	Sawn veneers are better than rotary cut veneers, which are apt to develop hair-cracks. Available in S. India in very large sizes and good for bottom boards.

Item No.	Trade Name.	Botanical Name.	Quantity Tons, log 1929-30.	Quantity Tons, log 1930-31.	Quantity Tons, log 1931-32.	REMARKS.
12	Shisham ..	Dalbergia sissoo ..	116	239	160	Used for dining car furniture.
	Indian rosewood ..	Dalbergia latifolia ..			2	
13	Laurel ..	Terminalia tomentosa	19	623	**1,041**	Also called asna, saj and matti. Used for bottom boards.
14	Kindal ..	Terminalia paniculata	..	84	**159**	Also called honal.
15	Badam ..	Terminalia procera ..	111	50	**59**	From Andamans. Available in large quantities. The Chief Forest Officer quotes Rs. 60 per ton c.i.f. Calcutta or Madras.
16	White chuglam ..	Terminalia bialata ..	19	14	**4**	From Andamans, available in large quantities.
17	*Hollock ..	Terminalia myriocarpa	..	26	**200**	From Assam, available in large quantities.
18	Benteak ..	Lagerstroemia lanceolata	74	325	**377**	
19	*Tavoy wood ..	Parashorea stellata	..	412	**251**	Should not be used in exposed situations.
20	*Ramdala (lampatti).	Duabanga sonneratioides.	5	230	**27**	An excellent timber for all general purposes. Does not warp or split and not prone to movement when seasoned.
21	Chaplash ..	Artocarpus chaplasha	..	173	**22**	Suitable for interior and ornamental work. A sound wood.
22	*Cham ..	Michelia champaca	3	132	..	A sound medium weight wood. Very durable under cover. Used for panelling and furniture.
23	*Jarul or Pyinma	Lagerstroemia flos-reginae	88	170	**382**	Andaman pyinma is Lagerstroemia hypoleuca, light and strong.
24	*Toon ..	Cedrela species ..	18	92	**106**	
25	Irul ..	Xylia dolabriformis	..	32	**20**	Hard but very durable even outdoors. Rather difficult to work.
26	Bija sal ..	Pterocarpus marsupium	340	372	**233**	Durable and handsome. One of the padauk family and well known as a fine timber, also called houné.
27	Babul ..	Acacia arabica ..	93	67	**47**	Chiefly for keys. Very durable. Satisfactory for carriage doors and side pillars.
28	*Thingan ..	Hopea odorata ..	..	76	**287**	A very good strong timber for constructional work. Deserves attention.
29	Dhaman ..	Grewia tiliaefolia ..	..	12	**86**	A good tool handle wood. Also called thadsal.

Item No.	Trade Name.	Botanical Name.	Quantity Tons, log 1929-30.	Quantity Tons, log 1930-31.	Quantity Tons, log 1931-32.	REMARKS.
30	Jack ..	Artocarpus integrifolia	..	13	9	Well known as an excellent furniture wood. Has been exported to Europe for furniture. Also called hebblesu.
31	*Yon ..	Anogeissus acuminata	..	46	253	Inclined to warp and twist even when kiln seasoned. Good for hammer shafts.
32	Semal ..	Bombax malabaricum	26	32	23	A very light wood. Useful for dust shields for axle boxes.
33	Amoora ..	Amoora wallichii ..	1	7	4	Also called white cedar.
33a	Chikrassy ..	Chikrassia tabularis	..	..	14	Figured logs obtainable from Burma in fair quantities. The wood of these logs, quarter-sawn, is very handsome.
34	Aini ..	Artocarpus hirsuta ..	97	7	32	Its density varies considerably and it is apt to have a woolly texture. It is durable, but its former reputation is rather inflated.
35	Vellapiney (belapine)	Vateria indica ..	47	4	..	Not recommended. Also called piney maram.
35a	Kolavu ..	Hardwickia pinnata	..	..	150	
†36	Malabar junglewood.	Mixed species ..	375	296	344	
†37	Miscellaneous hardwoods and jungle woods.	....	‡3,100	1,669	479	‡Included considerable quantities of laurel, item 13.
37a	Mixed scantlings	....	..	..	270	Kiln-seasoned at Lillooah and used by E. B. Railway.
		Foreign Imported Timbers.				
38	Hickory ..	Hicoria species ..	39	14	53	
39	Red lauan ..	Shorea negroensis and other species.	..	147	..	From Philippines and British North Borneo. Not recommended. Logs cracked badly in sun.
40	White lauan ..	Shorea mindanensis and eximia.	..	50	..	
41	Java teak ..	Tetramerista glabra	..	50	216	From Java. Described by Dr. Foxworthy, Timber Research Officer, Philippine Islands. "The wood will decay if left in contact with the ground subject to white-ant attack. Dries out slowly." It is not teak, but is sold in India as "golden teak" and "zaver teak."

Notes.—*Species included among those selected for the kiln-seasoning experiment at Lillooah, East Indian Railway.

†Nos. 36 and 37. It is requested that, as far as possible, a record may be kept in future of the species purchased.

Full descriptions of most of the above timbers will be found in :—

The Common Commercial Timbers of India and their Uses, by H. Trotter, I. F. S., Forest Economist, Forest Research Institute.

Obtainable from the Government of India, Central Publication Branch, 3, Government Place, West Calcutta, or V. P. P. from the Book Depot, Forest Research Institute, New Forest, Dehra Dun, U. P., at Rs. 1-12-0 *per copy (postage not included).*

REMARKS.

1. (*a*) Total amount spent on timber, other than sleepers, by Class I Railways :—

	Rs. lakhs.	
1927-28	140·6	including Rs. 2 lakhs imported timber purchased in India.
1928-29 ..	96·4	do. Rs. 8 lakhs do.
1929-30	108·7	do. Rs. 4·35 lakhs do.
1930-31	92·30	do. Rs. 8 lakhs do.
1931-32	**37·99**	do. Rs. **·59** lakhs do.

The effect of the reductions in coach building programmes, which started in 1930-31, is strikingly indicated by the figure of expenditure for 1931-32, which is actually over a crore less than the figure for 1927-28.

(*b*) Total amount of timber consumed in Carriage and Wagon shops:—

	Tons, log.	Percentage of total,—Burma teak.	Percentage of total,—Indian teak and indigenous timbers.
1927-28	34,000	69	31
1928-29	Not available		
1929-30	45,000	57	43
1930-31	42,000	50	50
1931-32	**29,000**	**40**	**60**

The growing tendency to make use of Indian teak and indigenous timbers, which are specially suitable for repairs and miscellaneous work in place of the more expensive Burma teak, has advanced by 10%. This is an important step, especially as the average price over all railways paid for Burma teak squares continued high, in the neighbourhood of Rs. 230 per ton compared with Rs. 240 during the last two years. The cheapest purchase made was square ends, 6′—14′ in length 10″ side and up, at Rs. 178 per ton, and the purchasers state that it is easier to see if the timber is sound throughout in these short lengths, and for a large variety of purposes these lengths are adequate. Considering the dullness of the market in Rangoon, and also in Java, throughout the year it is surprising that the average price paid in India was not lower. Whereas the price of nearly all other raw materials in the world has dropped at least 30 % during the last three years the fall in the price of Burma teak, sold in India, has been a comparatively slow process. A change may be expected to appear in the figures for 1932-33, as in July 1932 first class Indian quality Burma teak squares, average 30 c. ft. were purchased at from Rs. 167-8-0 to Rs. 172 a ton in Clacutta.

(*c*) Total consumption of Indian teak :—

	Tons, log.
1927-28	700 (2% of grand total).
1929-30	5,300 (12% do. do.).
1930-31	4,000 (10% do. do.).
1931-32	**3,600** (**12**% do. do.).

Several railways have placed trial orders for Malabar teak. Reports are being asked for when the logs have been converted.

The variation in price paid for bottom boards of Indian teak on different railways *i.e.*, from Rs. 106 to Rs. 238 per ton, is noticeable.

(*d*) Total consumption of indigenous timbers, other than teak :—

			Tons log.
1927-28	..	..	9,800 (29% of grand total).
1929-30	..	..	14,200 (31% do. do.)
1930-31	..	..	17,000 (40% do. do.).
1931-32	..	..	**14.000** (**48%** do. do.).

The consumption of indigenous timbers has risen to 48% over all railways. The North Western and the East Indian Railways, the railways which used the largest quantity of timber, employed indigenous timbers for 77% and 69% of their work. The cost of various species in the log averaged from Rs. 62 to Rs. 115 per ton, and as these railways between them consumed 5,500 tons this represents a very important saving.

(*e*) The total timber used was divided up as follows :-

				New Construction.	Repairs and Miscellaneous.
1927-28	..	..	..	42 per cent.	58 per cent.
1929-30	..	..	..	38 ,,	62 ,,
1930-31	..	..	..	33 ,,	67 ,,
1931-32	..	..	..	**31** ,,	**69** ,,

2. Satisfactory reports have been received of all the fourteen species being kiln seasoned at Lillooah, except that *yon* (*Anogeissus acuminata*), used for pillars, is reported to warp and twist during, and subsequent to, the kiln-seasoning. It also hardens to such an extent that it is only machinable with difficulty. This timber has done well in Burma in the shape of handles for hammers and picks without being kiln-seasoned.

The timbers being tried at Lillooah have now been employed in about 300 coaches on the East Indian Railway and all those coaches which have come in so far for overhaul have been found satisfactory. One unfavourable report was received as regards *haldu*, but in other instances it has proved satisfactory.

There is a large stock of kiln-seasoned timber at Lillooah sawn to the following convenient sizes :—

(1) Ceiling and Casing	..	.. $5'' \times 3\frac{3}{4}''$ to finish $4\frac{3}{4}'' \times \frac{1}{2}''$.
(2) Roof Boards	..	.. $5'' \times 1''$ to finish $4\frac{3}{4}'' \times \frac{3}{4}''$.
(3) Pillars intermediate	..	.. $4'' \times 2\frac{3}{4}''$ to finish $3\frac{3}{4}'' \times 2\frac{1}{2}''$.
(4) Pillars intermediate	..	.. $4\frac{7}{8}'' \times 2\frac{3}{4}''$ to finish $4\frac{5}{8}'' \times 2\frac{1}{2}''$.

Enquiries should be addressed direct to the Deputy Chief Mechanical Engineer, East Indian Railway, Lillooah, who will be glad to arrange for inspection before purchase and for a view of the kilns at work.

3. Two railways, the Bengal-Nagpur and the East Indian, are now trying the experiment of entrusting the purchase and inspection of the timber required for Carriage and Wagon Shops to the Eastern Group, Sleeper Control. This group is in an especially favourable position as regards obtaining supplies of sal, as with effect from 1st April 1932, it has absorbed the Central Sleeper Group area and therefore now covers the whole sal area in India. It is also well situated as regards supplies of Burma teak from Calcutta, C. P. teak and *haldu*. Recent quotations made by the Eastern Group are :—

Sal logs per ton ..	.. Rs. 75 f.o.r. B. N. Railway.
Sal bottom boards ($9'-6'' \times 5'' \times 2''$)	.. Rs. 1-12-0 each f.o.r. B. N. Railway.

Enquiries and orders from other railways, which should be addressed to the Sleeper Control Officer, Eastern Group, B. N. Railway House, Kidderpore, Calcutta, will be gladly received, as the larger the volume of orders through this channel becomes, the more hope there is of building up a sound connection with traders, and, further, it will be possible to keep inspection charges lower if they can be spread over a large quantity of material.

4. I shall welcome enquiries on any subject in connection with the purchase, identification or use of timbers and shall be obliged if the results of calls for tenders are reported to me.

SIMLA :

The 29th August 1932.

H. C. B. JOLLYE, *I.F.S.*,

Timber Advisory Officer, Railway Board.

DOMESTIC OCCURRENCES.

Birth.

Blanford.—On Aug. 18, 1932, at 10, Windermere Park, Rangoon, Burma, PEGGIE, wife of HARRY R. BLANFORD, O.B.E., I.F.S.—a son.

SALE OF ETCHING OF FOREST RESEARCH INSTITUTE.

Copies of an etching of the institute at Dehra Dun by Mrs. Tufnell Barett (M. Sherlock) are on sale price Rs. 20/- each at the President's Office. The Picture is $17'' \times 7''$ on a white mount and unframed. It is very well drawn and shows the five proportions of the building against a background of the Mussoorie hills.

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THE PRACTICAL USE OF ECOLOGY.

Foresters in many countries have long felt the need for an accurate classification of soils based upon the woodland types which they have once carried or are capable of producing. Within the last decade Great Britain has spent some 10 millions sterling on her planting programme, and much of the 20,000 acres now being stocked each year consists of bare ground with no existing forest growth. In selecting the trees to be planted it is therefore of obvious importance to know what species will prosper upon any given site, whether it has trees already on it or not. And in view of the extensive use of exotic conifers such as Sitka spruce and Douglas fir, these introduced species have also to be correlated with the native communities in which they can be expected to grow best. The practical application of ecological work is therefore of much importance to British foresters, and although in India our work is more restricted to existing forests, we are spending large sums of money on regeneration and plantation work where the right choice of species is an essential step in sound forestry technique.

We have received a most interesting booklet issued by the Oxford Department of Forestry: "Natural Woodlands of Britain and Ireland," in which Dr. M. L. Anderson has separated, on the basis of the best known indigenous trees, fifteen communities, varying from the beechwood of the chalk ranges of southern England, through the ashwoods of Derby and the Ochil Hills, to the moist oakwoods of the clays, the drier oakwoods of the sandier soils, the ash-alder and ash-birch communities of the Scottish and Irish lakes and glens, and the Scots pine and birch of the Highlands. The correlation of the various exotic species with the communities which suit them best is the first step, and can be done satisfactorily from the evidence of successful

plantations already established. The next and more difficult step is to classify the waste-land types now devoid of any forest growth, and frequently suffering from severe soil deterioration through exposure or misuse.

It is reasonable to presume that the surface vegetation even if shallow-rooted gives an indication of the nature of the food and water supply in the upper soil layers. The vegetation is probably a better indicator of the existing conditions than an elaborate chemical analysis, and its assessment is certainly more practicable, though this is not to say that we do not require the help of the soil chemist in working out many of our problems. So much attention has been paid in Britain during the last few years to the study of waste-land flora as an indication of its suitability or otherwise for planting various tree species that much overlapping has occurred. Surveys have been carried out by a great number of people each working in a restricted area, and as a result much confusion has resulted from a too intensive multiplication of local communities. The matter must first be dealt with upon lines sufficiently broad to make a framework for the whole country, such as Dr. Anderson has now prepared and into which each community can eventually be fitted. The simpler this classification can be kept the better, and this is where we in India can profit from the experience already purchased elsewhere through much painstaking research. Our research officers are now seeking to draw up such a framework of types for India, which we hope will soon be agreed on and published. With such a basis provided, anyone interested can then take up the more intensive local study of soil communities and woodland types, knowing that he has a reliable basis for his work.

Dr. Anderson's classification of waste-land types for Britain is based upon five arbitrary degrees of soil fertility, lettered A to E, in each of which there are three sub-classes based upon the normal supply of available moisture,—dry, moist, and wet being numbered 1, 2 and 3. Combinations of these give fifteen site-classes, which have been connected where possible with the nearest equivalent woodland type For instance, Fertility Class A gives :—A1 The Dry Grass-Herb

Community; A2 The Moist Grass-Herb Community; and A3 The Grass-Rush Communities; and the next lower class B, gives :—B1 The Dry Grass Community; B2 The Fern Communities; and B3 The Sedge Communities. To each of these Dr. Anderson has allotted a selection of tree species most suitable for plantation work, thus showing the very practical results to be obtained from an intensive study of waste-land plants.

Similar ecological work has been going forward in America for some years and the results have recently been published in pamphlet form as "Forest Cover Types of the Eastern United States," published by the Society of American Foresters. This in a way is more akin to our Indian problem in so far as it has to bring into one framework a great number of very varied types from an area of nearly 600,000 square miles of forest. This has been met by recognising 97 forest types, each of which has one or more dominant tree species which give it its name, such as :—38, Shortleaf pine; 39, Shortleaf pine—scarlet oak; 40, Shortleaf pine—southern red oak—scarlet oak. This is a type of nomenclature which incidentally is going to be very clumsy, as trinominal type-names should obviously be avoided if it is at all possible to do so. A framework for Indian conditions would also require to provide for the eventual correlation of grass-land types with the nearest equivalent forest type, because if our forest estate is ever to be fully productive, much work remains to be done in stocking with tree crops the very large areas of grass-land which lie within our forest boundaries.

FORESTS OF SWEDEN.

M. D. Chaturvedi, B.Sc. (Oxon.), I.F.S.

I.—General Remarks.

The importance of forests in the national economy of Sweden can best be realized when it is remembered that about 57 per cent. of its total land area (172,875 square miles) is classed as forest land. The total area of Sweden is 44·8 million hectares, out of which 3·8 million hectares are occupied by numerous lakes and waterways. The total

'forest land' is 23·6 million hectares, out of which 0·6 million hectares classed as uneconomic produces under $1 m^3$ per hect. per annum (or less than 14·3 cubic feet per acre). The distribution of forests over the country varies inversely with the stage of development reached. The northern parts, where rigorous climatic conditions render human habitation rather difficult, have the largest proportion of forest land, while in the middle and the southern parts of Sweden where mild climatic conditions prevail, the forest land has had to make room for a highly developed civilization and its ever-increasing requirements. Thus, about 60 per cent. of the total forest land is confined to the northern regions and the rest is distributed over the middle and the southern parts. The population of Sweden is about 6 millions, and each inhabitant has on an average about 10 acres of forest land to himself which is five times the corresponding share of an individual on the continent.

2.—CLIMATE.

Sweden lies between the 55th and the 69th northern degree of latitude, and as such, is one of the coldest countries of the North Temperate Zone. The northernmost part extends into the Arctic Zone, the annual mean temperature being—2° C to 3° C—with a yearly rainfall of 16 to 24 inches. In the southern parts the annual mean temperature is 6° to 7° C and the yearly rainfall is 16 to 32 inches.

3.—OWNERSHIP.

Most of the Swedish forests are privately owned, the State exercising a control on their management. The ownership of the forest land is given below :—

State forests	.. 3·8	million hectares	or 16 %	of forest land.
Public forests (communes, churches, etc).	.. 1·1	,, ,,	or 6 ..	,,
Private companies	6·7	.. ..	or 28 ,,	..
Private owners	.. 11·7	.. ..	or 50 ..	..
Total	.. 23·6	.. ,,	100 ..	..

Broadleaf Species along the Sea-shore near Knaberg Point.

Draining the Swamps at Vattholma.

About 83 per cent. of the State forests are confined to the northern regions. The importance of its forest wealth to the very existence of the Swedish nation needs no emphasizing even to the farmer owners. Not an inch of land is allowed to lie fallow. Private individual efforts are responsible for the planting of millions of plants all over the country every year. In fact, Sweden presents the unique spectacle of being one vast forest with little clearances here and there for towns, villages, agricultural fields, pasture grounds and factories.

I.—Organisation.

Although some manner of State control over the exploitation of forests can be traced as far back as the middle ages, it was not till the latter half of the 19th century that the forest management was organnised on scientific lines, when a great industrial development took place in Europe and Sweden was not slow to follow suit. The industrialization of Sweden led to a phenomenal demand for timber for house building, railway sleepers, paper pulp, match making, pit props and charcoal both for household use and iron factories, and it was then that the importance of its forest resources came to be practically demonstrated to the nation. The accessibility of its forests and the ease with which they regenerate coupled with a perfect net-work of streams and rivers which render transport extremely cheap, have placed Sweden in a unique position among the timber supplying countries of the world. Sweden holds practically a monopoly in matches and paper pulp industries, Canada being its sole serious competitor in the latter. The sea coast and the lakes to which the timber from the interior is floated at a nominal cost are bristling with a variety of forest industries. The total gross income from all forest industries is on the average about 50 million pounds; and the wood products amount to over 40 per cent. of the entire exports from Sweden.

The present forest organisation dates from 1860. For purposes of administration the State and public forests have been placed under the control of the crown land department (*domänverket*). A central board of authority (*domänstyrelsen*) has been constituted for

administrative purposes as under :—

Director.

Vice-director.

7 Assistant Directors, and 1 Sales Director.

The pay of the Director, Vice-director, Sales Director and Assistant Director is 30,000, 17,000, 17,000, and 10,000 kronen (18 Kr.=1£) per annum respectively. The bureau staff of each assistant director consists of one chief and one assistant, both being *jägmastares*. One assistant director is in charge of the working plans for the whole country, two belong to the agricultural department, and one assistant director is in charge of the finances and the organisation of the executive staff (*skogsstaten*). The remaining three assistant directors supervise the working of the state and the public forests which have been divided into three circles for this purpose. Each circle has four or five sub-circles. There are 13 sub-circles in all, each under an *overjägmästare* corresponding to a senior divisional forest officer. In each sub-circle there are 10-12 *revirs* (divisions) each under a *jägmästare* (D.F.O.). There are 134 *revirs* at present. A *revir* is further sub-divided into ranges each of which is in charge of a ranger, there being about 600 ranges. The net revenue from the state forests goes to the (*domänfonden*) crown land fund which at the end of 1927 stood at 23·6 million pounds ; the net income of the year from the state forests alone being 845,000 pounds.

The control over the privately owned forests is exercised through provincial forest boards (of three members) of which there are 25, one in each province. Provincial authorities appoint two members and the third is appointed by the Central Government. Each board has at its disposal one or two *jägmästares*, and its chief duty is to ensure that the Forest Laws (as amended in 1923) are followed by private owners. The Forest Laws permit improvement fellings in immature woods (thinnings), while the exploitation of the mature woods is conditional on the state of their reproduction. In mountainous districts and the Lapp territory of the far north special protective laws have been enacted.

The Upper Farm Houses at Kulbacksliden (Vindeln).

Sample Plot No. 40. Scots Pine.

5.—GROWING STOCK.

Rigorous climatic conditions make the Swedish forest flora particularly in the north exceedingly simple. Except for a small southernmost part of the country which falls within the Mid-European Region with beech (*Fagus silvatica*) as the characteristic tree, Sweden pre-eminently belongs to the North European Coniferous Region. Pine (*Pinus sylvestris*), spruce (*Picea excelsa*) and occasional birch (*Betula odorata* and *verrucosa*) are the main species of this region. Pine occurs in pure stands mostly in the north and on comparatively poor soils, the undergrowth being lichens (*Cladina*, *Cetraria*, etc.) and *Vaccinia*. Fertile and moist areas are characterised by pure spruce stands with mosses (*Hylocomia*, etc.) on the ground. The central and the southern part of Sweden, representing moderate climatic conditions have largely mixed stands of pine and spruce. Here and there, notably in the south and the middle of Sweden, one meets with alder, ash, aspen, elm, lime, maple and oaks. There are some larch areas as well.

The National Forest Survey which sought to ascertain the forest resources of Sweden was completed in 1929. This gigantic task took six years to accomplish and cost about 67,000 pounds or 0·28 pence per acre of productive forest land. The procedure adopted was to take strips 33 feet (10 metres) wide and to count and measure along a system of survey lines all trees, omitting only those under 4″ d. b. h. Sample trees were taken for each species and diameter class, the personal factor being eliminated as far as possible, and their height, taper, volume, increment, age, and defects if any were duly recorded. Their position with reference to the drag-line (or the centre line) of the 10-metre strip was also noted. The area falling in the strips was also classified as arable or forest land, pasture, bog, rock, garden or road, etc. In productive forest areas their quality and the type to which they belong were also indicated. These survey lines were usually drawn at right angles to the main topographical directions prevailing in Sweden and the distance between them was progressively reduced from 20 kilometres in the north (12·4 miles), to 1 kilometre (0·62 mile) in the south according to the economic importance of the growing

stock. The closer the strips, the higher was the accuracy ensured. The survey involved a complete enumeration on a belt 32,300 miles long and 33 feet wide and the measurement of 180,000 sample trees. The method employed was checked and it was found that a high standard of accuracy was attained by the strip survey. The total volume of wood and its annual increment (without bark) was found to be 50,062 and 1,683 million cubic feet, respectively. A special report giving details of the survey is now in course of compilation. Against this might be mentioned the annual consumption of timber which amounts to 1,462 million cubic feet, 2/3rds of which is exported.

6.—EDUCATION.

A School of Forestry was established at Stockholm in October 1828 and has already celebrated its centenary. The earliest professors were mainly inspired by the German foresters and their theories. A *jägmästare* takes 4 years to finish his course, while short courses of 18 months for the employees of timber companies are also available. There are 5 schools distributed throughout Sweden for the training of rangers. The officer in charge of a ranger school is invariably a *jägmästare* with a *revir* (division) for demonstration purposes. There is also a private school for rangers.

7.—FOREST RESEARCH.

Forest research which was largely carried on by the School of Forestry and other enthusiasts in the State Service was centralized in 1902. The *Statens Skogsförsöksanstalten* (Forest Research Institute) has three distinct sections :—

1. Sylviculture. 1 head and 3 assistants.
2. Botany and Soil Science. 1 head, 3 assistants and 2 chemists (ladies).
3. Entomology. A head and an assistant.

An extra section for the exclusive study of the special problems of regeneration in the north of Sweden was created in 1916. There are six rangers attached to the forest research. The investigations are

mostly confined to the following three experimental forests (*Försökspark*) representing typical Swedish conditions :—

1. Svartberget and Kulbacksliden. North Sweden.
2. Siljansfors. Mid-Sweden.
3. Tönnersjöhedens. South Sweden.

The area of each of these experimental forests ranges from 2,500 to 3,000 acres. Other experimental and sample plots are distributed all over Sweden.

The programme of research is discussed once every five years at a meeting consisting of :—

1. Heads of Research (3).
2. Principal of the School of Forestry (1).
3. Jägmästares (3) selected by the Board of Forestry.
4. The Head of the Extra Section.
5. The Board of Forestry.

The Board of Forestry consists of five members and exercises control over the Forest Research Institute and the School of Forestry. Its members are :—

1. President.
2. Vice-president.
3. Director of the Society of Timber Exporters.
4. Director of the Swedish Geological Survey.
5. General Director of the Swedish State Forests and a Secretary.

The Board is selected by the Prime Minister and is approved by the King.

In 1902, the Research Institute was allotted a sum of about 900 pounds for its expenses, the present budget being about 14,000 pounds.

8.—Some Sylvicultural Experiments.

Both Svartberget and Kulbäcksliden afford some instructive examples of methods employed in investigating forest problems in North Sweden. They are situated near Vindeln railway station and

lie about 30 miles from the east coast. The height above sea level varies from 500 to 1,000 feet approximately. These experimental stations were established in 1923 and have an area of about 2,500 acres each. The annual mean temperature is about 1°C. and the average rainfall is just under 20 inches. The greater part of these forests is covered with moraine (consisting of well packed boulders, gravel, sand, silt, loam and clay) which sometimes lies under glacial and post glacial sediments. Valleys and depressions are characterised by glacifluvial sands covered by peat bogs. The soil has on the whole a podsolic profile which is characterised by the surface layer of undecomposed acidic humus covering a bleached layer under which follow in order a colloid rich layer usually reddish, yellow, brown or black, and the subsoil, an unmodified quaternary sediment.

Pine and spruce mixed here and there with birch constitute the main crops of these forests. Three distinct types can be distinguished with the help of ground vegetation :—

1. Lichens (*Cladonia* spp.) type.
   - *a.* Driest localities and exposed to fire in recent times. Pure crops of pine (branching quite near the ground) with occasional patches of spruce and birch. The growth of pine is extremely slow, not exceeding 55 feet in height in 200 years. Branches usually laden with lichens. Regeneration of spruce and birch generally absent. Ground cover is characterised by *Vaccinium vitis-idæa* and *Calluna vulgaris*.
   - (*b*) Pine mixed with spruce and birch. *Vaccinium myrtillus* and *Calluna vulgaris* are characteristic of such areas.
2. *Hylocomium* type.
   - *a.* With *Vaccinium myrtillus*.
   - *b.* With *Vaccinium* and *Dryopteris linnæana*. *Oxalis* also occurs.
   - *c.* With *Vaccinium* and weeds like *Geranium silvaticum*, *Mulgedium alpinum*, etc.
3. *Polytrichum* and *Sphagnum* type. Predominated by pine. Spruce and birch also occur.

Microscopic examination of the frequency of fossil pollen of various species in different layers of peat in bogs has led Dr. Malmström to believe that after the melting of ice pine and birch predominantly occupied the area. Spruce occurs only in comparatively higher layers of peat and its invasion seems to have taken place under a pine overwood about 4,000 years ago. Spruce owing to its being a shade-bearing species flourishes under pine and would have ousted the pine had it not been for the forest fires which it could not resist, and which gave pine an advantage over it. These fossil studies have yielded very interesting conclusions on the rate of invasion of peat bogs in forest land. It has been shown by Dr. Malmström at Kulbäcksliden that the progress of peat bogs is extremely slow, contrary to the belief popularly held both in Sweden and Finland.

The influence of thinnings on soil temperatures, availability of nitrogen, pH ion concentration and increment are the subjects of a study at Svartberget. A number of plots with varying degrees of thinning have been established and observations regarding temperatures pH ion concentration, and mobilisation of nitrogen are taken from time to time. If these plots were identical in all respects except for thinnings it would have been quite easy to come to definite conclusions about the influence of thinnings on these factors; but initially identical plots are difficult to obtain in actual practice, and therefore the variation of each plot was previously determined before the thinnings were carried out.

Other sylvicultural studies include a study of the influence of burning on the reproduction of conifers: root competition of pine seedlings with the trees in the upper canopy; and the reaction of the sub-soil after working the upper humus layer. At Hällnäs the Director of the Rangers' School has some interesting experiments on thinnings in areas where slow growing spruce is thinned to make room for pine and birch, and on the influence of brushwood lying about on the ground on the development of pine seedlings. A plot has been reserved as a specimen of the virgin forest.

At Alkwetten an experiment was started in 1911 by the Forest Research Institute to investigate the suitability of Wagner's strip

regeneration method to conditions prevailing in Mid-Sweden. In 1926 the following modifications were effected to suit the local conditions :-

(*i*) Modifications to eliminate the danger against N. E. wind.

(*ii*) Overmature and unsound trees to be felled all over the area.

(*iii*) Advance regeneration to be *encouraged by widening* groups.

(*iv*) Heavy *thinnings in the strip to* be felled next.

Wagner's north-to-south strips of regeneration in their original form are not suited to this area. As a matter of fact an east-to-west strip at right angles to Wagner's direction has regenerated itself. The speed of regeneration which was about six feet per year till 1926 has been quickened by adopting the above modifications.

Sample plots are dotted all over Sweden. Study of thinnings over sample plots is carried out not by making them initially identical, but by taking into account the variable factors. Here and there one also finds Forest Parks which are managed only from the aesthetic point of view.

9. WORKING PLAN ORGANISATION.

The Assistant Director in charge of the Working Plans Branch of the Swedish Forests has the following staff :-

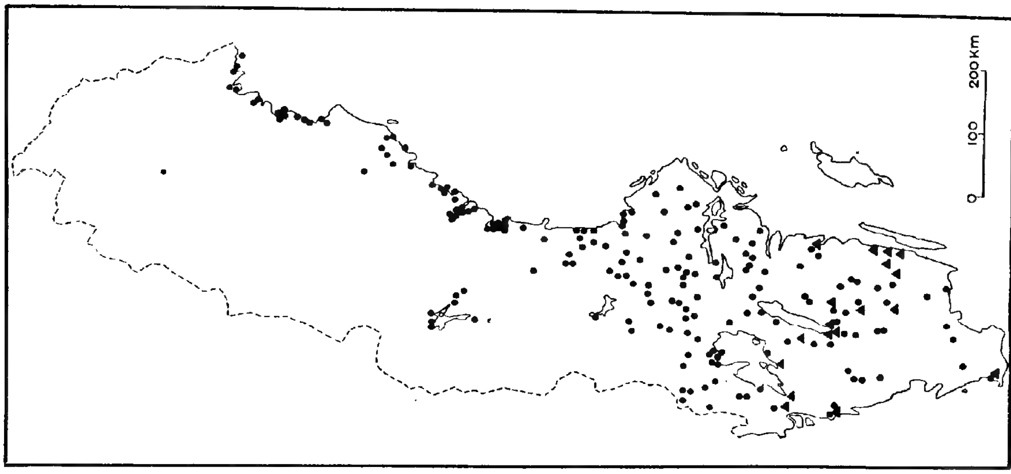
Assistant Director.

,, ——Bureau Chief (usually a *Jägmästare*).

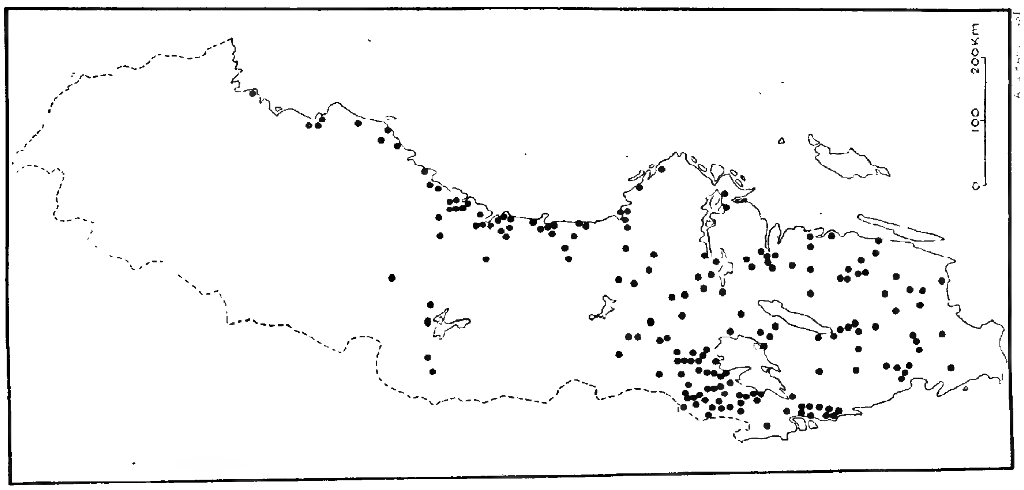
,, ——Bureau Assistants and Clerks.

8 Working Plans Superintendents. (=senior D.F.O's.)

Each Superintendent has 6 to 8 assistants who are further assisted by rangers. The field work is done by the assistants and the plans are compiled in the head office by the Superintendents though formerly the assistants actually wrote the plans. Each plan is revised after 10 years. As many as 500 plans are compiled every year. More than half the forests are managed according to working plans. Working plans exist for the State and public forests (commune, church and



• *Saw-mills.* ▲ *Match factories.*



• *Wood-pulp mills and paper mills.*

1 *The mountain-limit of pine.*
2 *Forest regions.*
3 *Regions with sparse of thin forests.*
4 *Regions practically devoid of forests.*

company owned). Forests belonging to private owners and farmers have more or less a systematic management under the control of the Provincial Boards but generally no working plans are made for them.

Older plans were generally drawn up according to the German methods for each forest in a *revir* (division). The annual yield was calculated for 20 years and was based on the growing stock, age and rotation, the exploitation being chiefly confined to the oldest age class. The growing stock was mapped, enumerated and reduced to a single quality class. The enumerations were carried out sometimes on the whole area, sometimes by the linear survey method, and sometimes the volumes were ascertained by an ocular estimate.

The procedure which was codified in 1916 has been recently considerably modified (1929). The 1916 Instructions had been criticised as involving rather unreliable volume estimation, and unnecessary expense and labour in treating each forest in a *revir* as a unit of management. The latest plans are compiled for a *revir* or exploitation unit and not for each forest. The volume method has been replaced by an area method. The stock maps have been simplified, and the field work much reduced. The chief aim of the management is to improve the stock by carrying out improvement fellings in all stands capable of development. For this purpose, a forest is divided into the following five Maturity Classes representing different stages of development :—

Class V.—Old mature woods, diseased woods including woods with accidental fires or other accidents like wind, snow break, etc., rendering them unfit for further development. Fellings are made with a view to obtain natural regeneration. Market conditions also govern the pace at which the extraction of material proceeds.

Class IV.—Mature woods. Preparatory fellings for regeneration.

Class III.—Middle woods. Where thinnings are saleable.

Class II.—Young woods. In need of thinnings.

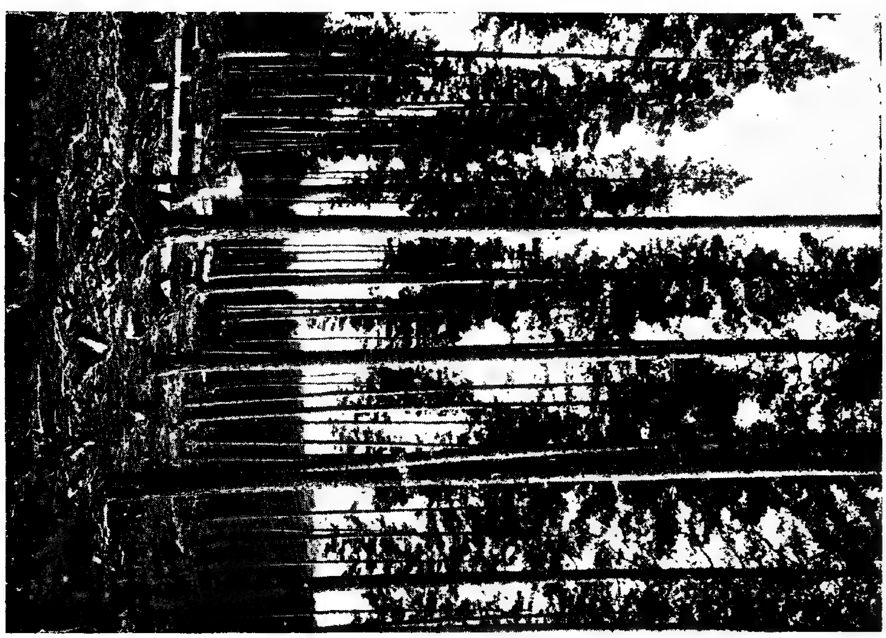
Class I.—Regeneration with seed bearers in the upper storey.

Emphasis is laid not on the final cut based on rotation and sustained yield which have been relegated to a secondary position, but on the improvement of the stock, and trees capable of development may be left irrespective of age. The area to be gone over every year depends on what areas require such treatment and on the prescribed interval of cutting which varies from 3 to 5 years depending on the quality and the situation of a tract with respect to markets. The annual area rather than the annual yield constitutes the primary objective in a working plan. This has led to a great abbreviation of the work involved in the compilation of plans. Rough ocular volume estimates and for some stands linear survey estimates suffice, while increment is obtained from the National Forest Survey statistics. The amount of material removed every year is carefully noted and mapped, and checked against the increment at the end of 10 years when the stocks are remeasured. The plans are intended only for the guidance of the jägmästare and not for absolute observance.

10.—UTILIZATION.

The export of forest products from Sweden can be traced right back to the Middle Ages. The saw-mill industry, however, was not developed till the middle of the nineteenth century. Great Britain reduced the duty on Swedish timber in 1821 and abolished it in 1866. Ever since, the Swedish timber trade has continued to grow, and Great Britain has constituted the main outlet for the wood products of Sweden. The development of the Swedish shipping and consequent transport facilities opened up new avenues for the export of the Swedish timber and wood products and many other new markets were reached. The steam engine revolutionized the saw-mill industry and since 1841, when the first steam driven saw-mill was founded, the progress of saw-mills has been very rapid. The saw-mills are equipped with the most modern machinery and have labour of unrivalled skill at their disposal. A network of rivers and water channels for floating timber and logging facilities during the cold weather on sledges render transport extremely cheap. Even under difficult topographical conditions snowfall renders haulage of trees extremely

Reproduction of Pine at Ozoble.



Pine Forest at Malingsbo.

easy. The logging channels total 20,000 miles in length, and about 75,000,000 logs are floated annually. In the year 1926 Sweden had about 400 large saw-mills with 1,200 saw frames in addition to about 3,000 small saw-mills, and their output was valued at 336,000,000 kronen. The total export of sawn material in 1925 amounted to 3,900,000 cubic metres valued at 291,500,000 kronen.

The wood pulp industry is a concomitant feature of most of the saw-mills, and frequently pulp making assumes greater importance than the saw mill products. The copious supply of water, and cheap electric power from water-falls coupled with a continuous supply of soft-woods have contributed towards the development of the pulp industry which has made great strides during the last 50 years. In the year 1892, the total output of mechanical and chemical pulp was 46,000 and 48,000 tons, rising in 1925 to 439,000 and 1,294,300 tons, respectively (dry weight). Before the Great War Sweden was the leading exporter of the chemical pulp to the world's paper mills. In recent years the waste products of pulp mills have yielded alcohol recovered from the sulphite process waste. Other by-products are resin, methanol, acetone, etc.

Although large quantities of wood pulp are exported, the paper mills of Sweden also consume a considerable amount for the manufacture of cardboards, paper and newsprint. The first paper mill in Sweden was probably erected towards the end of the sixteenth century. Upto 1830 these mills were hand-driven and the total output of 80 mills which existed in the middle of the nineteenth century did not exceed 10,000 tons. With the advent of the steam engine the industry was completely mechanized. The beginning of the present century witnessed great development in the Swedish paper industry. The total output of paper has risen from 50,000 to 500,000 tons during the last 25 years, out of which about 70 per cent. is exported. Sweden specializes particularly in tissue paper, grease-proof, imitation parchment, newsprint and wrappers. The ideal organization of a paper mill running side by side with a pulp and saw-mill has made Swedish paper and pulp unrivalled in the world. The sole competitors of Sweden in

pulp production to-day are Canada and to some extent Finland. The largest paper mills are Kvarnsveden, Hallsta, Matfors, Fiskeby, etc.

Exports of the most important wood products are given below :—

QUANTITY IN TONS.

		1913	1925	1925 % of 1913
Pit-props	..	408,700	385,000	94
Sawn and Planed Wood-goods	..	3,584,200	2,929,600	82
White Mechanical Pulp	..	264,000	328,000	124
Dry Unbleached Sulphite	..	508,000	629,800	124
„ „ Sulphate	..	85,900	247,700	288
Newsprint	..	61,600	173,300	281
Other kinds of paper	..	127,900	201,050	157

The chief markets are :—Great Britain, France, Germany, Holland, Denmark, Belgium, Spain, S. Africa, Australia and other overseas countries.

The Swedish match industry with its ramifications the world over is too well known to deserve a mention here.

With grateful acknowledgment of the help given to me by Professor Hesselman and Dr. Langlet. To Mr. Sven Petrini my special thanks are due for personally conducting me through some of the most interesting experimental areas in Sweden and placing at my disposal all available information regarding them. Dr. Langlet very kindly supplied the photographs, and maps have been taken from Gustav Asbrink's book on Sweden. The information contained in this article has been collected from various books, bulletins and magazines too numerous to mention.

THE RAIN GAUGE.

By Jupiter Pluvius.

The Chief Conservator called for the rainfall statistics and these were after some delay produced and subject to some caustic remarks about dirt and untidiness in writing, they were passed and all was well. That evening, however, the Chief accompanied by the Divisional Forest Officer inspected the premises (the Divisional Forest Officer humming under his breath " Muckin, about the Garden ") and while

nosing round came across the rain gauge. Why he should have been so misguided as to remove the top and gaze inside passes understanding but this he did. Amid a deathly silence the Divisional Forest Officer gives a horrified glance at the Chief for the inside was empty of its bottle. "It is so much more accurate to measure the rain without the bottle, isn't it," said the Chief, and with this cutting remark moved on. A short time afterwards whilst the Chief was busily engaged enquiring from a palpitating guard why the wire fence round the deodar nursery was more like a slack clothes-line than a fence, the Divisional Forest Officer had an opportunity of demanding from the Ranger why the "blankety blank" the bottle was not in its proper place and where the "blank" was it. "Oh! Sir, the bottle is being cleaned," said the Ranger: "Cleaned of what," asked the infuriated Divisional Forest Officer. "Of rain, Sir," says the Ranger. Swallowing a dry sob the Divisional Forest Officer hastens to the assistance of the guard, expecting to hear that worthy tell the Chief that the wire of the fence is purposely kept slack, so that the little children of the Ranger can crawl through it and play inside. Half an hour later as the party are returning for a much needed drink, a sharp shower of rain starts to fall, the door of the Ranger's house opens and a guard doubles out smartly bearing aloft the missing bottle: this he tenderly places in the rain gauge—seeing which the Divisional Forest Officer mutters to himself "The quality of mercy is not strained, it droppeth as the gentle rain from heaven upon the earth beneath, it is twice blessed. Oh! well, I suppose I shall have to show mercy on the Ranger, and anyhow it can now rain like hell as far as I'm concerned."

EUROPEAN SYLVICULTURAL RESEARCH; PART III, INHERITANCE PROBLEMS.

By H. G. Champion, I.F.S.

There are various difficulties in carrying out investigations into inheritance problems with trees which have resulted in our knowledge being decidedly backward in comparison with that available for other

plant crops and animals. Some of these difficulties tend to be exaggerated, but some undoubtedly exist. The chief is the length of the tree generation, or rather the time taken to reach reproductive maturity, but even here, not a few trees such as larches and some pines will bear healthy seed after 10 or 12 years and instances are on record of a single investigator following through several tree generations. Another is the fact that since trees as far as we know are mostly cross pollinated, only one parent is known with certainty. The difficulties of controlled or artificial pollination of forest trees are real but by no means insurmountable and it is many years now since Klotsch produced hybrid pines, elms, etc. (*circa* 1840).

To the French forester Vilmorin goes the credit of the earliest extensive comparative investigations of plantations raised side by side from seed of a given species but from different sources. He demonstrated at Les Barres that the different origins shewed markedly different development and that racial characters tended to be reproduced, but his work did not receive the attention it deserved.

Conspicuous among later workers were Cieslar in Austria and Engler in Switzerland, both of whom laid out a large number of experiments covering a wide field, many of which were seen during the tour. In 1906-7 was initiated the best example we have in forest history of co-operative research, the international investigation into the importance of seed origin for Scots pine.

Dr. Schwappach appears to have been the prime mover in the matter and the Prussian Research Institute at Eberswalde undertook the collection, testing and distributing of the seed from selected crops in 11 selected localities. The seed was sent out to the co-operating countries and plantations were raised with varying success. The most complete series of plots are to be seen at Chorin (Eberswalde), Tharandt, and Eglisau (near Zürich) all of which were visited, but many of the other trials have also given valuable information. Everyone who has a chance, ought to visit one or more of these plantations. Dr. Wiedemann has quite recently written up a general account of this investigation collecting the latest information for all the repetitions, whilst Dr. Bürger has also published a most

interesting account of the Swiss experiments. As the plantations are 24 years old, there has been time to get past the juvenile stages which are apt to mislead, and to give a fair idea of probable further development. The results are available in the publications referred to and so do not require detailed discussion here: suffice it to say, that they fully bear out Vilmorin's early conclusions at the same time giving much more precise information. In a general way, the best results are to be expected with seed collected from the best indigenous local crops, but where the local strain is inferior, definite improvement is possible by the introduction of good stock from another locality with closely similar climate. Races of markedly good form tend to retain that form, but may still not be the best to grow if their growth is relatively slow. Races of relatively poor form but quick growth may prove the most economic where the inferior stems can be largely eliminated in the earlier thinnings.

A scrutiny of the experiments and their records reveals varying attitudes towards various subsidiary points necessitating much care in comparing results from one investigation with those from another and in deriving general conclusions. Most investigations have concerned themselves with the country or district of origin of tree seed in bulk, with the idea that there are probably a number of geographical or climatic strains of different value for use in different localities. It was therefore aimed at getting a sample of seed from well grown stands of undoubtedly authentic indigenous origin, such sample coming from a number of trees; any tendency to individual characters which might be inherited was accordingly intentionally merged to reduce the problem to one of average race characters. The cone parents were known and there would be a strong probability that the big majority of the pollen parents would be of the same strain. There are those who assert that if inheritance of racial characters is proved, that of individual characters is likewise demonstrated, but it is possible and in our opinion correct, to view the matter differently. Cieslar in a classical experiment with oak to be seen at Mariabrunn, expressly restricted himself to one or two mother trees for each origin, but to some extent thereby rather stultified the investigation by attempting

to cover too wide a field. There were not enough separate mother trees of one origin to permit of clear conclusions as to individual inheritance, nor enough mixed to give an acceptable racial average.

Special interest centres round the question of the possible inheritance of bad stem form, branchiness and crookedness, whether racial or individual. In India, we now have the example of spiral grain in *Pinus longifolia* which has been demonstrated to be heritable as a race character for seed collected in localities where the defect is very strongly developed, but for which we now greatly need definite information as to its behaviour as an individual character. In Europe, two closely comparable features have been much studied and discussed, *viz.*, "sabre-bole" in larch, and crookedness in Scots pine. A heated controversy recently took place in the European forestry periodicals centring round a long paper by Dr. Tschermak of Mariabrunn on the former subject.

From an extensive study of natural crops growing under a wide range of conditions, he concluded that sabre-bole was the direct product of the environment and that no race of larch was free from it. The criticism mostly amounts to shewing that a decision on such matters cannot be reached from field observation, progeny tests being essential. For that matter, such tests are now in progress in Austria on a reasonably large scale; no visible difference is to be seen at present between the offspring of individual good and bad larch. It may be suggested that direct inheritance of sabre-bole is unlikely, but the inheritance of a greater or less tendency to react in this way to environmental influences is probable.

At Bonaduz in the Swiss Alps occur long over-worked forests of very poor growth and form growing on an unfavourable soil long subject to over-grazing—just as in the vicinity of so many villages in India. Both pine and larch occur, and it has now been clearly demonstrated that plantations raised elsewhere from Bonaduz seed reproduce their bad characters,—crooked boles and low branching habit. Furthermore, plantations of good strains raised at Bonaduz shew up definitely better than the local strain. This example is very closely comparable indeed with the Indian one quoted and is surely traceable to a

common cause,—human selection by removal of all but the worst trees over several generations resulting ultimately in the presence among the survivors of a high proportion of trees of genetically inferior growth.

In the series of pine origin plots at Eglisau (Switzerland), seed from good and bad mother trees was sown separately for two origins and though the differences are not great, the offspring of the former do shew definitely somewhat better stem form than the latter. Much further work has still to be done to permit of certain conclusions on this important point, but all the indications are that pending clear proof to the contrary, we ought to allow no seed to be collected from badly shaped trees or races.

Turning to individual investigations inspected and discussed on the spot with those responsible, many interesting points come up. At Chorin, the chief interest lay in the thinning treatment applied to the plots of the international pine origin experiment. The different origins differed conspicuously among themselves, even considering only those which had come through the attacks of needle cast, and the question arose as to the most advisable thinning procedure to keep them comparable for as long as possible. A solution was found in sub-dividing each plot into two and thinning one primarily for volume production (*i.e.*, in practice on crown spread and spacing) and the other for stem form. The resultant difference between the two halves is sometimes most striking and requires to be seen to be believed, and it is evident that two sets of conclusions will be required. The other point of uniformity in time and intensity of thinning has been wisely solved by dealing with each plot on its merits, thinning each when and as it would be thinned over large areas in divisional practice. Attempts to thin all at the same time and to the same basal area would defeat the object of uniformity more than it would help it.

At Tharandt, the corresponding set of plots is likewise exceptionally interesting from the research as well as the practical point of view. At Tharandt we find believers in statistical methods of dealing with experimental data, and happen to have an investigation which particularly lends itself to statistical analysis. The origin plots were

laid out in a single contouring series along an apparently uniform hill side. Casual inspection reveals the fact that whereas bracken fern is the dominant soil cover in the upper parts of the plots, it is absent in the lower part, and closer investigation and soil sampling have revealed that the plots happen to lie astride the line of junction of two different sandstone formations known as Quader and Palner-sandstein, naturally with a transition zone where the soils are mixed. For purposes of comparing the origins *inter se*, five indicator plots were measured up in each, two on each soil type and one on the transition. The five sets permitted of computation of the error of the mean values, and it was found that this error actually exceeded the amount of the differences between the origin means, which latter were thus mathematically insignificant and proved nothing. But if plots on one soil type only were compared, significant differences were demonstrated and as might be expected, results were not identical on the two types. Of course this sub-division of the original plots is a very different matter from having the same number of sub-divisions suitably distributed over the experimental area in the first place, but the analysis has certainly led to a more correct interpretation of results.

Another interesting point was the demonstration of the mixed origin of the Scottish seed origin collected from an Invernesshire forest believed to be natural. Ocular inspection suggested the presence of trees of typically lowland and highland type, and here statistical analysis shewed an unduly flat diameter frequency curve and a double maximum to the height frequency curve virtually proving the suggestion to be correct. Finally, the plots of two origins had to be excluded from the experiment owing to the fact that they were obviously influenced by the neighbouring taller forest, a suitable surround not having been provided. All such experiments require special care in ensuring that the whole of the plots remain comparable to the end of investigation, and a surround of adequate width should be planted up at the same time as the plots, as can usually be done easily with local seed.

In further illustration of the last mentioned point, reference may again be made to Cieslar's 1903 oak investigation at Mariabrunn.

There were 21 plots in a block of seven plots by three, each plot having 200 plants spaced 1 m. by 1 m. The size of the plots is obviously inadequate for anything beyond the small pole stage, but only the five central plots are without marginal trees, and among the remaining sixteen, all four aspects are represented introducing differences of unknown magnitude; moreover on one side stands an old wood unquestionably influencing the development of the plots more than origin difference is likely to, and the other sides are more or less open.

Reverting to the Tharandt pine origin plots, there are still two points in the latest assessment which are of more than local interest. One is the method adopted of predicting development for a further period by the comparison of measurements on the best ten stems in the subplots with those of the subplot averages: this seems not unreasonable if one thinks it over, despite its limitations. The other point which does not claim to be a new discovery, is that bark thickness is significantly different for different origins, so that a different sequence of origins is obtained for average diameter or basal area if under-bark measurements are considered instead of over-bark ones.

Dr. Münch also has an exceptionally varied lot of seed origin experiments at Tharandt which apart from their intrinsic value and interest are important from the advanced technique used in lay-out and replications. Nowhere else in Europe has this matter received proper attention except in Great Britain, and it can safely be predicted that future generations will place proportionally more reliance on the results he obtains than on those of other workers content with single plots and usually inadequate numbers of plants.

A matter which has been much written about and discussed, and for which experiments are to be seen in many places, is that of the early and late budding spruce, the former being usually the more vigorous but very liable to damage from late frosts. Many spruce crops—even the majority—will be found to be a mixture of forms and the regeneration likewise, and by selective elimination it is possible to obtain a new crop of either form from the same seedling mixture. The probability is that the present mixed crops are only the result of the use of mixed seed or nursery stock in the past and the process of

selective use of the form best adapted to a given locality is only a restoration of the original natural distribution when the late form was the race characteristic of high attitudes and frosty localities. It was thought that cone colour was a safe indication of time of budding, 'red' cones indicating the late budding form, but though there is a correlation, it is not an infallible rule. Probably hybridisation comes into the question. We have in India red and green coned spruce and deodar, purple and yellow staminate blue pine and so on. These species have a wide altitudinal range, and it behoves us not to commit the same mistakes as our European confreres of a generation or two back.

The time-honoured investigation of the effect on the offspring of the age of the mother tree might have been thought to have been worked out, but a piece of work recently finished and published by Dr. Busse of Tharandt illustrates the need of check on modern lines of many of the older dicta which are really based on very inadequate evidence. He dealt with seven age classes and had four replications for each, laid out on the randomised block method. Without going into the technicalities of the method, it may be said that this arrangement permits of the calculation of the experimental error due to the chance variations of soil and conditions which remain even after special selection for uniformity, so that differences between the mean values for the several progenies can be checked against this error. Differences which on the old single plot method would have been considered as quite definite may now be seen to have no real significance in that they may merely be due to the chances involved in the allocation of the plots, whilst other differences though small may be shewn to be real. The results in this instance are interesting because they run counter to the general belief, for the descendants of the younger mother trees exhibit after 15 seasons' growth, somewhat quicker height development and greater hardiness than those of the higher (but still not overmature) age classes.

In England, the special turn taken by investigations into inheritance and problems is a search for specially hardy races for afforestation work at high altitudes, in exposed localities or an unfavourable soils. As most of the seed used has to be purchased or imported,

the experiments often really test rather the value of a certain trade source than anything else and a lack of uniformity of material used was noted. Britain's share in the international pine seed origin investigation was not a very brilliant one and though many tests must have been made up and down the country, no comparative plots more than a year or two old were seen.

Looking for general conclusions for India from foreign work on this subject, it may be said that many of the underlying general principles have been established beyond need of repetition. Thus the existence for all species studied of climatic races with different hereditary constitution, and the far reaching effects of using the wrong race are unquestionable. Altitudinal races equally certainly exist in many species and we can ignore their existence at our peril. Soil races similarly have been proved to exist in enough cases to warn us against any great change in this respect also, but the possibility of replacing a bad race on a bad soil will always be worth investigating. Within these races, we need not bother ourselves much whether the seed came from old or young trees, dominant or dominated stems, provided it is of good size, weight and germinative power. The use of badly shaped trees for seed is fraught with danger particularly when such trees predominate—as in residual trees in village waste. There remains, however, a big field for investigation in India, for we have to determine what races require to be distinguished for all our important trees such as teak, deodar, acacias, pines and so on. We have also to deal with an enormously wider range of trees than European foresters who only have the relatively narrow field provided by the *Coniferæ* and *Cupuliferæ*, and considerable differences in degree if not in kind must be expected. It may be noted, too, that species history in past epochs has undoubtedly been of great influence in bringing about racial differentiation and the geological history of India has been very different from that of North Europe. It is evident that we have more than enough scope for valuable research without expending too much time and effort in repeating the time-honoured investigations of Europe, but profiting from the results so patiently accumulated for our benefit as well as Europe's.

WILL SOMETHING ELSE DO ?

BY L. N. SEAMAN.

As long as supplies of teak, deodar, *sal, sissoo,* and other well-known and universally accepted species were available in almost unlimited quantity and at low price little thought was given to the possibility of using "something else." The old established favourites possess combinations of figure, colour, strength, workability, retention of shape and durability which, learned from experience, won for them their popularity and fit them peculiarly for the various uses to which they are put. But, though these woods are naturally superior, there are others which are good, and still others which, by proper care in preparation and appropriate treatment can be made good for many purposes. Such possible substitutes deserve special consideration, not only because they can be obtained more cheaply, but also because their sale in appreciable quantities, even at low prices, offers a potential addition to the income derivable from forest products.

In the selection of substitutes for many purposes one of the first considerations is strength. True, appearance, retention of shape, and durability are also important in some cases, and must be given due thought, but for many uses the really vital qualities are strength and durability. Woods which are not naturally durable can often be satisfactorily treated with preservatives. The object of this note is to provide approximate information as to strength which will make possible an intelligent selection of substitutes.

The word "strength," as applied to wood, is rather ambiguous unless qualified in some way. A wood which is very strong in resistance to side compression may be brittle and relatively weak as a beam, particularly if subjected to blows or sudden shocks. For structural uses, however, the "strength" of wood is most commonly associated with its ability to carry loads when used as a beam or rafter, and in the following lists the transverse, or "beam strength" of the wood is made the basis of classification.

For purposes of comparison the different species have been divided into groups, each of which is associated with the name of one of the

better known woods. Any of the species found in one group if used as a beam, can be taken as having approximately the same strength* for practical building, as the species which is named as typical of that group. At the same time the individuals of the group are arranged in descending order of their strengths, and the divisions between successive groups are arbitrary. It follows, therefore, that the strength difference between the last species named in one group and those at the top of the following group is not great.

In most cases it has been possible to assign one strength position to each species irrespective of the region in which it has grown. Environment, however, has considerable influence and in a few cases the strengths of the same species from different localities have been so different that it has been deemed advisable to allot them different places in the strength groups. In this way teak from the Central Indian Region has been placed in a lower strength class than teak from Burma and Malabar, *Terminalia tomentosa* from Madras has been placed lower than the same species from the United Provinces, and *Dipterocarpus griffithii* from the Andamans is not as strong as that received from Burma. Other species also have exhibited variations in strength with locality of growth, but not of sufficient magnitude to necessitate a distinction in their strength grouping.

Exceptionally Strong (Pyinkado Group).

1. Mesua ferrea.
2. Sageræa listeri.
3. Pterocarpus macrocarpus.
4. Schleichera trijuga.
5. Shorea obtusa.
6. Hopea glabra.
7. Xylia dolabriformis.

Extremely Strong (Sal Group).

1. Hopea parviflora.
2. Anogeissus acuminata.
3. Acacia arabica.
4. Dipterocarpus tuberculatus.
5. Pentacme suavis.
6. Berrya ammonilla.
7. Shorea robusta.
8. Grewia tiliaefolia.
9. Heritiera minor.
10. Chloroxylon swietenia.
11. Dipterocarpus turbinatus.
12. Heterophragma adenophyllum.
13. Homalium tomentosum.
14. Terminalia tomentosa (U. P.).
15. Dipterocarpus griffithii (Burma).
16. Pterocarpus marsupium.

* For important work, in which careful design is contemplated, tables of safe working stresses should be obtained from the Forest Research Institute.

Very Strong (Teak Group).

1. Xylia xylocarpa.
2. Planchonia andamanica.
3. Hopea odorata.
4. Tectona grandis (Burma and Malabar).
5. Anogeissus latifolia.
6. Pterocarpus dalbergioides.
7. Terminalia belerica.
8. Dipterocarpus macrocarpus.
9. Acrocarpus fraxinifolius.
10. Lagerstrœmia microcarpa.
11. Terminalia manii.
12. Dipterocarpus kerrii.
13. Cullenia excelsa.
14. Eugenia gardneri.
15. Pentace burmanica.
16. Terminalia pyrifolia.

Strong (Jaman Group).

1. Mitragyna diversifolia.
2. Dalbergia latifolia.
3. Artocarpus hirsuta.
4. Dalbergia sissoo.
5. Parashorea stellata.
6. Terminalia paniculata.
7. Diospyros pyrrhocarpa.
8. Terminalia bialata.
9. Dichopsis elliptica.
10. Eugenia jambolana.
11. Dipterocarpus alatus.
12. Calophyllum tomentosum.
13. Lagerstrœmia tomentosa.
14. Lagerstrœmia parviflora
15. Morus alba.
16. Dysoxylum glandulosum.
17. Tectona grandis (Central Indian region).
18. Albizzia lebbek.
19. Albizzia procera.
20. Terminalia tomentosa (Madras).
21. Calophyllum elatum.
22. Stereospermum suaveolens.
23. Dipterocarpus griffithii (Andamans).

Moderately Strong (Haldu Group).

1. Careya arborea.
2. Stereospermum chelonoides.
3. Adina cordifolia.
4. Calophyllum wightianum.
5. Dillenia indica.
6. Machilus spp.
7. Cedrus deodara.
8. Phœbe hainesiana.
9. Schima wallichii.
10. Aegle marmelos.
11. Lagerstrœmia hypoleuca.
12. Lagerstrœmia flos-reginæ.
13. Dillenia pentagyna.
14. Bassia latifolia.
15. Cedrela serrata.
16. Chickrassia tabularis.
17. Hardwickia binata.
18. Swintonia floribunda.
19. Vateria indica.
20. Terminalia procera.
21. Terminalia arjuna.
22. Mangifera indica.
23. Podocarpus neriifolia.
24. Juglans fallax.
25. Diospyros melanoxylon.
26. Michelia excelsa.

Somewhat Weak (Chir Group).

1. Mitragyna parvifolia.
2. Sonneratia apetala.
3. Melanorrhœa usitata.
4. Abies pindrow.
5. Bischofia javanica.
6. Pinus longifolia.
7. Garuga pinnata.
8. Michelia champaca.
9. Polyalthia fragrans.
10. Holoptelea integrifolia.
11. Michelia cathcartii.
12. Shorea assamica.

Weak (Lampatti Group).

1. Picea morinda.
2. Duabanga sonneratioides.
3. Cedrela toona.
4. Lannea grandis.
5. Boswellia serrata.
6. Pinus excelsa.

Very Weak (Semul Group).

1. Lophopetalum wightianum.
2. Hymenodictyon excelsum.
3. Parishia insignis.
4. Canarium euphyllum.
5. Alstonia scholaris.
6. Bombax insigne.
7. Bombax malabarium.
8. Cryptomeria japonica.

THE GENUS CYMBOPOGON IN NORTH-WEST INDIA.

BY R. N. PARKER, I.F.S.

In taking up the genus *Cymbopogon* for the Flora of the Upper Gangetic Plain I have taken the opportunity of revising the determinations of these grasses in the Dehra Dun Herbarium irrespective of their distribution in so far as the species occur in the area of the flora. This has led to certain conclusions and given additions to their known ranges which it may be useful to record.

Dr. Stapf in *Kew Bulletin* 1906, pp. 297-363, gives an account of the genus in India which as regards N. W. India requires modification owing to the subsequent description of *C. parkeri* Stapf in Kew Bull., 1929, p. 10. This species is related to both *C. schœnanthus* Spreng. and *C. jwarancusa* Schult. Of these two species Stapf says their distributions overlap and numerous transition forms occur. As regards the Dehra Dun Herbarium most of these transition forms turn out to be *C. parkeri* Stapf. There still however remain a number of specimens which might equally well be referred to *C. schœnanthus* or *C. jwarancusa*.

Stapf quotes no specimens of *C. schœnanthus* Spreng. as coming from Baluchistan. We have the following :—Monro 27th April 1893 ; Lace 3,833 (ex parte *i.e.* Sibi 22nd December 1888 and Kau 22nd May 1888) ; Stocks 816 Baluchistañ Hills. This last specimen is quoted by Stapf and by Blatter and McCann (*Journ. Bomb. Nat. Hist. Soc.* 32, p. 431) as coming from Sind. Stocks 690 came from Hyderabad, Sind.

For *C. jwarancusa* Schult. the following specimens are quoted as giving additional localities :—

Baluchistan :—Banerji 8148, Col. Strong, Lace 3833 (ex parte). Duthie's Collector 19041. Dir :- Harriss 16762.

Sind Shikarpur :—Herb. Dehra 22774.

Assam Goapara :—Herb. Dehra 4348 ; King's Collector.

In describing *C. parkeri* Stapf only quotes specimens from the Etawah district. The species is however widely distributed in N. W. India as the following specimens show :—

Baluchistan.—Monro ; Lace 3833 (ex-parte) ; Duthie's Collector 20666.

Waziristan.—Harsukh 15721. *Kurrum.*—Aitchison 602. *Cherat.* —Collett. *Chitral.*—Giles.

Sind.- Herb. Dalzell ; Karachi.—Herb. Cooke.

Hazara.—Col. Johnson 21067, 25618.

Kashmir Astor Valley :—Duthie 12301.

Punjab Salt Range.—Aitchison 59 ; Warth ; McDonell. Rawalpindi :—Aitchison 97, 562 (ex parte for one of his numbers). Hissar :—Duthie 5062 ; Harsukh 20705.

Jodhpur :—King.

It seems probable that some of these collectors recognized this species as distinct from *C. schœnanthus* or *jwarancusa, e.g.,* Monro, Lace and Collett, but Lace's specimens were given the same number as other species and Collett's were mixed in mounting. Col. Johnson certainly detected the grass as different from *jwarancusa* and sent in specimens of both. Both he and Aitchison on one of his collections has noted that the grass is lemon-scented. As found in the Etawah district and under cultivation in Dehra Dun this grass is not lemon-scented.

Cymbopogon distans (Nees) comb. nova. We have one specimen of this from the Gonda district, all our other specimens being Himalayan and the lowest elevation quoted being 4—5,000 feet. Such a distribution is comparable with that of *Cymbopogon gidarba* Haines of which we have specimens from Simla and Almora at 4,500—6,000 feet and one from Monghyr in the plains of Bihar. Haines quotes specimens from Gya and Hazaribagh which I have not seen. *C. gidarba* may therefore be expected to occur in the plains of the United Provinces though hitherto it has not been collected there. On one sheet of *C. distans* collected by A. E. Osmaston the collector has noted " a lemon-scented grass." Although it has been collected several times by Duthie, Gamble and Lace all of whom would doubtless have mentioned a lemon scent if it occurred, no other sheet has any such indication.

It seems probable that both *C. parkeri* and *C. distans* occur in two forms, one lemon-scented and the other not, comparable with the *motia* and *sofia* varieties of *Cymbopogon martinii*. Observations in the field can settle if this is the case and perhaps some forest official who knows these aromatic grasses can make them. If specimens of the same species with and without a lemon-scent can be found and sent with corresponding notes on the scent they will be welcome for the Dehra Dun herbarium.

IDENTIFICATION OF TEAK DEFOLIATORS IN THE FIELD.

By S. N. Chatterjee.

The purpose of this note is to enable the forest officer to identify the more important defoliators of teak in their feeding stages. The terms used are not technical and no apparatus is necessary, except perhaps that a hand lens will be useful for examining larvæ in their small early stages. Only those insects which have been found, up to now, to be of appreciable importance as defoliators, have been included. Other species may have to be added in the future. It should be noted that many insects will be found resting on teak leaves without feeding on them; these of course are not referred to now.

The insect names are marked with one, two or three stars according to their importance as pests: three stars indicates a major pest. *Hapalia machæralis* Wlk. and *Hybloea puera* Cr. feed throughout the year except in Northern India where they hibernate for about 5 months of the winter. *Apogonia* spp. feed in the early rains, and all the other species feed in a lesser or greater degree throughout the rainy season.

The insects fall into three groups, *caterpillars*, *beetles* and *grass-hoppers*: these names will be familiar to all.

GROUP I: CATERPILLARS.

[Soft bodied larvæ of moths with three pairs of thoracic legs and in addition, two to five pairs of legs ("prolegs") on the abdomen.]

1. Body smooth, *i.e.*, not distinctly hairy ....(2)

Body distinctly hairy ....(7)

2. Hind end of the body with a small but distinct tail or horn length up to about 4 inches (*Sphingidae*)......................(3)

Hind end of the body without such a tail or horn length up to about $1\frac{5}{8}$ inches ....(4)

3. Colour green with a slanting pale green band on each body segment; feeds during August, September; length up to about 3 inches: ....*Psilogramma menephron Cr.***

Colour variable: grass green with slanting yellow bands; or greenish yellow with purple bands; or mottled dirty brown with a dirty white band; feeds August, September; length up to about 4 inches: ....*Acherontia lachesis F.* *

4. With only one pair of prolegs in addition to the pair at the hind end of the body: .... "loopers," (*Geometridae*), (5)

With four pairs of prolegs in addition to the hind pair. ....(6)

5. Colour grey, with no distinct markings; length up to about $1\frac{1}{4}$ inches: ....*Ascotis selenaria* v. *imparata Wlk.**

Colour reddish-yellow mottled with black; length up to about $1\frac{1}{4}$ inches:............................ .*Ascotis infixaria* Wlk.*

Light yellow or grey with a longitudinal dark brown band along the back and another along each side; length up to about $1\frac{1}{2}$ inches: ....*Ectropis bhurmitra* Wlk.*

Grey or reddish yellow with a faint transverse white band on each segment; or in the small early stages, black with transverse white bands; length up to about $1\frac{5}{8}$ inches: ....*Hyposidra* sp.*

6. Head black; larger larva with colour black, sometimes with an orange band along the middle; smaller ashy grey larva makes a characteristic shelter by folding a portion of a leaf; length up to about $1\frac{1}{4}$ inches: ....*Hyblæa puera* Cr. (*Noctuidæ*).***

Head yellow; larger larvæ yellow, (darker along the back), dotted with black; small larvæ dirty white; larva lives under a sheet of fine silk threads; length up to about 1 inch: ....*Hapalia machæralis* Wlk. (*Pyralidæ*).***

7. Body very hairy but with no tufts of long hairs; length up to about 2 inches: ......*Diacrisia obliqua* var. *confusa* But. (*Arctiidæ*) and ....*Eupterpote* sp. (*Eupterotidæ*)**.

Body with separate tufts of long hairs; length up to about $1\frac{1}{4}$ inches: ....*Dasychira* sp.* (*Lipariidæ*).

GROUP II: BEETLES.

1. Head produced into a rostrum or snout (weevils)........(2).
   Head not so produced...........................(3).

2. Elytra (*i.e.*, the hard wing-cases) bright green at the sides with no dark stripe; feeds during rains:....*Sympiezomias beesoni Mshl.***

Elytra bright metallic green at the sides but with a dark stripe running through the green zone; feeds during the rains: ....*Astycus aurovittatus Heller.***

3. Colour metallic green or blue; up to about $\frac{1}{4}$ inch in length: ....*Colasposoma* sp. (*Chrysomelidæ*).*

Colour light or dark brown; length up to about $\frac{1}{4}$ inch..:........ ....*Apogonia* sp. (*Melolonthidæ*).**

GROUP III: GRASSHOPPERS.

1. With very short antennæ, *Acridiidæ* (several species).**
   With very long antennæ, *Locustidæ* (several species).*

WILD LIFE IN SOUTH INDIA.

BY RANDOLPH C. MORRIS, F.Z.S.

In a consideration of the present position of wild life in South India it is to be remembered that in the Madras Presidency, as well as in Coorg and in the States of Mysore, Travancore and Cochin, many different types of country are represented, the open plains holding black-buck and chinkara; the scrub, bamboo and low lying deciduous forests the habitat of chital, sambhur, tiger, panther and bear; and the higher evergreen and upper deciduous forests the home of the gaur and the habitat proper of sambhur. Here also bear are to be found, and occasionally wandering tiger and panther. The little muntjac or barking deer adapts itself to evergreen, deciduous, and bamboo jungles; the four-horned antelope to plateaux and grass hills ranging from 3,000 feet to 5,500 feet in elevation. The Nilgiri goat are to be found on the cliffs of the Nilgiris, Anamallais, Nelliampathics, Varadamallais, Palghat Hills, the Palnis, the High Wavy Hills, and on the Travancore and Cochin Hills, chiefly the High Range.

Mr. R. D. Richmond, the Chief Conservator of Forests, Madras, has very kindly supplied me with notes on the position of game in the districts of the Madras Presidency other than the Forest Divisions of North Coimbatore and Kollegal (Coimbatore District), and I cannot do better than reproduce them :—

" In the Godavari, where the gaur is probably on the increase, chital and sambhur are not so numerous as they were : much of the damage, strangely enough, being done with the bow and arrow. For very many years there has been little game in the Ganjam district, so little in fact that the balance of nature is upset and the district is principally notorious for man-eating tigers. The populated north of this vast tract comprising Vizagapatam and the Jeypore Agency, which is a Native State, has little game left in it, but the sparsely populated south is well off for all kinds, and is the only place in the Madras Presidency where the buffalo is found. The Southern portion of the Eastern Ghats are of little interest except for chinkara in the foothills and some antelope on the plains. The 2,000 square miles of the Nallamalai Hills contain plenty of game of all kinds, and it is

strange that the gaur does not occur. What are known as the Ceded Districts contain very little at the present day. Once the haunt of the elephant, forest destruction has had the inevitable result of driving the game away as well as reducing parts of the country almost to the condition of desert. There are, however, still antelope and chinkara, while sambhur are to be found in the hills of Cuddapah and Chittoor; in fact there is still plenty of game in the latter district, even if the glory of the Chamla Valley has departed—due to fewer Europeans visiting it. The Javadi and Salem hills contain gaur which are closely protected and which do some damage to forest works, but the rest of the game animals are poorly represented. The same may be said of the southern part of the Madura district, principally interesting from the fact that a herd of gaur was cut off when the railway was constructed and, well protected, have persisted. The Palni Hills of Madura provide representative animals on the slopes, the Nilgiri goat on the edges of the plateau (7,000 feet) while the gaur occasionally visits the plateau. Tinnevelley is fairly well off and here too the Nilgiri goat is to be found though it appears that the numbers have decreased. The forest area of South Coimbatore is famous for the 'Grassy Hills,' on the borders of the Cochin State at an elevation of 6,000 feet to 8,000 feet, the Nilgiri goat being common, while elephant and gaur are to be found on the open grass. The forests of Malabar (that is to say the protected areas, for there are considerable tracts of private forest land in which there is no protection or shooting regulations), are for the most part exceedingly well stocked with game and other animals of all kinds, particularly elephant and gaur. The forest areas belonging to Government are more compact than elsewhere and there is far less population inside them and on their edges—consequently there is less poaching.

"To judge by the complaints of damage done by wild animals it would be supposed that South Kanara teemed with wild life; but such is far from being the case, the complaints being in reinforcement of agitation for the abolition of the forests. But in the upper hills there are sambhur and there are a few gaur, also elephants. The tiger is accused of killing great numbers of domesticated cattle, and though

it is a fact that the mortality of cattle from wild animals is greater here than elsewhere, the tiger is in fact rare, the delinquent being the panther living in low rocky hills distant from the real forests, and killing cattle as there is nothing else to live on.

"The Nilgiris, a district at elevations from 1,000 feet to 8,000 feet is richer in fauna of all kinds than any other. Naturally well endowed in this respect, protection in the last forty or fifty years has been good on the whole. The shooting is regulated by a Game Association, the members of which are all those who take out annual shooting licenses—these are mostly European—and a special protective staff is entertained. The Nilgiri goat's habitat is the Nilgiris—(north of which the family is unrepresented until the tahr is found in the Himalayas) Madura, parts of Malabar, Cochin, Travancore and Tinnevelley in the extreme south. It has definitely increased of recent years. Sambhur abound on the plateau and a beneficial practice is now permitted in the shooting of a limited number of hinds. There are also gaur, vulnerable to epidemics of rinderpest from time to time; chital and sambhur are common on the slopes and lower plateau; muntjac are exceedingly common as also are elephants. Tigers are commonly found on the upper plateau. The extension of the planting industry has reduced the area available, but there is still plenty of room and whereas certain animals may appear to be reduced in numbers from time to time in different places, there seems to be no ground for apprehension that game animals are decreasing."

Mr. Richmond has, I think, left out the large forest areas in North Coimbatore for me to deal with. These areas, comprising the Kollegal and North Coimbatore Forest Divisions not long ago held large numbers of elephant, gaur, sambhur, chital, tiger and panther. The elephants still abound and gaur are fairly numerous, though an epidemic of rinderpest imported by cattle grazing in the Reserve carried off large numbers of them in 1919, and now, 13 years later, the gaur are still not nearly so common as in the years before the disease broke out. The chital however have been almost wiped out. This applies also to the sambhur that were to be found in the chital country and on the lower slopes of the Billigirirangan Hills. Localities which a

few years back held large herds of chital and were good spots for tiger now hold few or none of the former and only an occasional wanderer of the latter, poaching and netting being responsible. Sambhur on the higher slopes are still fairly common in some parts but not in others.

Wild dogs are paying increasing attention to these areas through lack of food elsewhere. A large number of the ryots living in the areas adjoining the Reserves have guns, and most of them are not above hiring or lending them out. Forest subordinates seem to be indifferent to what is going on or incapable of doing anything to stop it. Machans are openly erected over water holes and salt-licks and netting is being increasingly resorted to. In a recent letter to the Collector of the District I have urged the necessity of—

(1) allowing ryots to possess only short barelled guns for crop protection;

(2) a house-to-house search for illicit guns in all villages adjoining or near Forest Reserves supervised by an Assistant Superintendent of Police ;

(3) the tightening up of the clause against poaching, and severe sentences on those convicted of breaches of these laws;

(4) an Act to prohibit the marketing of horns, hides and flesh of game.

One bison grazing area has already been closed to cattle grazing, and I am trying to induce Government to agree to close another, in which some bison contracted foot and mouth disease last year. The cattle grazing in this area last year were suffering from this disease.

In connection with Mr. Richmond's notes, and from a study of the list of game shot in the Nilgiris district in the last 26 years, it would appear that sambhur have decreased here as elsewhere, and I think this is the case; combined with a shortage of good shootable heads. Chital are said to be largely poached at the eastern foot of the Nilgiris by Muhammadans in cars. Bison in the Madras Presidency are in no immediate danger; though in some parts they do contract diseases through cattle being allowed to graze on their grounds, and in one

locality in Kollegal they are being poached by Muhammadans, in other areas this does not apply, and there are larger numbers of them. Elephants are increasing and measures ought to be taken to have all solitaries destroyed as potential rogues. With most of the ryots possessing guns they do not hesitate to shoot at and often wound elephants raiding their crops.

In Mysore bison are fairly common in the Reserved High Forests of Mysore, Shimoga and Kadur districts though outbreaks of rinderpest imported through cattle grazing in those parts have carried off large numbers. Sambhur and chital occur in the above districts, but are badly poached. The Mysore Game Officer describes sambhur as fast diminishing in numbers, and referring to chital he reports " they will be extinct at no distant date unless special steps are taken to protect them." This apparently also applies to black-buck and chinkara. Elephants are common in the forests of the Mysore district and are, in spite of the kheddahs, increasing. Tiger are also described as decreasing though he admits this is partly due to the practice of netting tiger and trapping them in pits.

In Coorg the Chief Forest Officer reports that elephant and bison are on the increase, but that there is a scarcity of sambhur, chital and pig and that these are decreasing rapidly on account of poaching. Good heads of sambhur are rarely seen. Bear are rare, while tiger and panther are not common.

Regarding Travancore, the Conservator of Forests reports that elephant, bison, sambhur, ibex (Nilgiri goat), muntjac and tiger are fairly common in the forest clad hill ranges up to and including the Cardamom Hills, and on the Kannan Devan Hills or High Range. This may also be taken as applying to the State of Cochin.

Mr. Richmond holds quite rightly that one of the best methods of controlling poaching lies in the presence of licensed sportsmen, but their visits are comparatively few and far between in areas outside the Nilgiris and these tracts are overrun by poachers. Rewards for the destruction of wild dogs are given while Malabar squirrels and black monkeys are protected.

In regard to the Indian license holder Mr. Richmond says :—

" While the closest attention is paid to certain classes who will not ordinarily infringe the rules, it is to be feared that the Indian license holder, hardly one of whom shoots for sport's sake, who pays little attention to the conditions of his license, and who will entrust his gun to other parties, is poorly controlled. Of recent years the policy has been to grant licenses to possess arms to a greater and greater extent, and any one with a gun is a potential poacher. Also the class of license issued for crop protection is responsible for considerable damage, damage which might be mitigated would those responsible consent to the peasant being put to the inconvenience of depositing his arms with the police at times when there are no crops to protect. A further handicap to game conservation is the extremely rapid Indianisation of the Forest Service; officers of the new class take little or no interest in natural history, or in the preservation of wild life, and as a rule other activities prevent them from paying sufficient attention to this part of their duties. The difficulty is that there is no public opinion on the subject of game preservation in the country, and until this has been created, little will be accomplished. The jungleman is principally a poacher, either for food, or to obtain meat for sale."

I should like to express my thanks to Mr. Richmond for his assistance and to the Chief Conservator of Forests, Mysore, the Conservator of Forests, Travancore, the Chief Forest Officer, Coorg, and others who have provided me with notes covering the game position in their provinces.

RECENT BAMBOO PULPING INVESTIGATIONS.

Recently investigations were carried out in the Paper Pulp Section of the Forest Research Institute on dead culms of *Dendrocalamus strictus* bamboos from Hyderabad State, to test their suitability as paper-making raw materials. Some of the provisional conclusions that can be deduced from the investigations may be summarised as follows, though they require to be confirmed by experiments with similar

bamboos from other areas and of other species :—

1. The specific gravity of dead culms is lower than that of mature culms from living clumps. This means a larger number of dead culms per ton and consequently a higher cost of extraction per ton from forests ;
2. The percentage of lignin in dead culms is higher than in living culms. The dead culms, therefore, require a comparatively more drastic digestion treatment than living culms, the total quantity of chemicals for digestion being the same in both cases ;
3. The percentage of cellulose in dead culms is higher than in living culms. The yield of paper per ton of raw material is, therefore, higher in the case of dead culms than in that of living culms : and
4. The quality of paper produced from dead culms is as good as that of paper produced from living culms.

Dead and flowered bamboos appear, therefore, quite satisfactory as paper making materials unless they are attacked by borers.

The above facts are interesting as they go a long way towards laying the bogey of flowering bamboos interrupting supplies of raw material for paper mills. The bamboos actually used in this case had flowered four years previously, which tends to show that even though an area of bamboo may flower, the old culms are perfectly suitable for paper making purposes for many years to come, and that supplies can be drawn from areas on which bamboos have flowered pending the establishment of the new crop.

FINANCIAL FORECAST FOR AN IRRIGATED PLANTATION.

BY BAHADUR SINGH, P.F.S.

[*This is a revised estimate based on more accurate figures than were given in the estimate printed in our May* 1932 *number, pages* 252–254. —ED.]

1. STATEMENT OF FORECAST OF REVENUE AND EXPENDITURE.

The following statement shows the forecast of the revenue and expenditure which may be expected during the formation of a 10,000

acre-plantation during a rotation of 20 years. The sequence of sowing and temporary cultivation will be in accordance with the figures given in Appendix I. It is presumed that water will be given on a field crop basis, *viz.* a 3-foot delta over the gross area of the plantation ; and that the *malikana* rate will be Rs. 10/- per acre :—

No. of Item.	REVENUE.	Rs.	Rs.
1.	Temporary cultivation over 95,000 acres @ Rs. 10/- *malikana* for 95,000 acres and Rs. 2/- land revenue for 76,000 acres ..	..	11,02,000
2.	Sale of seeds and cuttings ..	..	5,000
3.	Sale of thinning wood :—		
I.	*Thinnings.*—7,500 acres at 500 cubic feet per acre = 37,50,000 cubic feet @ Rs. 18/- per thousand cubic feet ..	67,500	
II.	*Thinnings.*—5,000 acres at 800 cubic feet per acre = 4,000,000 cubic feet at Rs. 25/- per thousand cubic feet ..	1,00,000	
III.	*Thinnings.*—2,500 acres at 800 cubic feet per acre = 2,000,000 cubic feet at Rs. 30/- per thousand cubic feet ..	60,000	
			2,27,500
4.	Sale of brushwood at Rs. 100/- per annum ..	..	2,000
5.	Sale of grass ..	..	12,000
6.	Compensation and miscellaneous ..	..	10,000
	GRAND TOTAL ..	..	13,58,500

EXPENDITURE.

Conservancy and Works.

		Rs.	Rs.
1.	Purchase of bullocks, 2 pairs at 500/- a pair	..	1,000
2.	Feed and keep of bullocks at Rs. 40/- per mensem ..	..	9,600
3.	Purchase of stores, tools and plant at Rs. 350/- per annum ..	..	7,000
4.	Construction of compartment and boundary roads, culverts and bridges :—		
	Roads 200 miles at Rs. 40/- per mile ..	8,000	
	Reinforced concrete culverts 50 @ Rs. 50/- each ..	2,500	
	Bridges 20 at Rs. 150/- each ..	3,000	
			13,500

No. of Item.	REVENUE.	*Rs.*	*Rs.*
5.	Construction of buildings :—		
	(*a*) 1/3rd cost of Divisional Forest Officer's residence and Divisional Office ..	6,000	
	(*b*) Rest-house with out-houses ..	13,000	
	(*c*) Range quarters with out-houses ..	5,000	
	(*d*) Range Office with dispensary and out-houses ..	3,000	
	(*e*) 6 quarters for Foresters and Range Clerk @ Rs. 1,570/- each ..	9,420	
	(*f*) Quarters for 24 Forest Guards @ Rs. 450/- each ..	10,800	
	(*g*) Quarters for *Beldars* 100 @ Rs. 240/- each	24,000	
	(*h*) Seed godown ..	1,100	
	(*i*) Bullock and cart shed ..	960	
			73,280
6.	Construction of one 8′ diameter well ..	4,700	
	,, ,, 3′	800	
	,, ,, 6′	1,500	
			7,000
7.	Maintenance of roads, buildings, wells and compound ..	..	30,000
8.	Demarcation ..	..	1,500
9.	Fire protection ..	..	5,000
10.	Fencing (Nursery, etc.) ..	..	2,000
11.	Construction of main water-courses ..	..	10,000
12.	Collection of seed ..	..	1,000
13.	Trenching 10,000 acres @ Rs. 12/- per acre (6″ trenches) ..	..	1,20,000
14.	Sowing and planting 10,000 acres @ Rs. 2/4/- per acre ..	..	22,500
15.	Cost of irrigation 1,05,000 acres @ Re. -/8/- per acre ..	..	52,500
16.	Water rate on 105,000 acres @ Re. 4/2/- per acre 3 feet delta ..	..	4,33,125
17.	Maintenance of water-courses and silt clearing over 105,000 acres @ Re. -/8/- per acre ..	..	52,500
18.	Weeding over 10,000 acres at Re. 1/- per acre ..	..	10,000
19.	*Kana* stubbing on old plantation 105,000 acres @ Re. -/1/6 per acre ..	..	9,844
20.	Re-opening of trenches over 50,000 acres @ Rs. 1/6/- per acre ..	..	68,750
21.	Restocking failures over 1,000 acres @ Rs. 2/4/- per acre ..	..	2,250
22.	B. IX Miscellaneous at Rs. 300/- per annum	..	6,000
	Total Conservancy and Works	..	9,38,349

ESTABLISHMENT.

Period.	*Particulars.*	*Amount.* Rs.
20 years ..	*1/3rd share of the pay of 1 Divisional Forest Officer at Rs. 750/- per mensem, 1 Head Clerk at Rs. 100/- per mensem, 3 junior clerks at Rs. 50/- per mensem each, and 3 office peons at Rs. 14/- per mensem each ..	83,360
	1 Range Officer at Rs. 300/- per mensem ..	72,000
	1 Range clerk at Rs. 40/- per mensem ..	9,600
	1 Range office peon at Rs. 14/- per mensem	3,360
	1 Mali at Rs. 25/- per mensem ..	6,000
	1 Forester at Rs. 40 per mensem ..	9,600
	8 Forest Guards at Rs. 18/- per mensem each ..	34,560
15 years ..	2 Foresters at Rs. 40/- per mensem each ..	14,400
	6 Forest Guards at Rs. 18/- per mensem each ..	19,440
10 years ..	1 Forester at Rs. 40/- per mensem ..	4,800
	4 Forest Guards at Rs. 18/- per mensem each ..	8,640
5 years ..	1 Forester at Rs. 40/- per mensem ..	2,400
	6 Forest Guards at Rs. 18/- per mensem each ..	6,480
All periods ..	Plantation allowance to Forest Guards at Rs. 2/- per mensem each :—8 Forest Guards for 20 years, 6 for 15 years, 4 for 10 years and 6 for 5 years ..	7,680
20 years ..	*1/3rd share of travelling allowance of Divisional Forest Officer for 20 years @ Rs. 120/- per mensem ..	9,600
	Travelling allowance of Range Officer and protective staff at Rs. 70/- per mensem	16,800
	*1/3rd share of travelling allowance of divisional office establishment at Rs. 25/- per mensem ..	6,000
	Travelling allowance of range peon at Rs. 5/- per mensem ..	1,200
	*Stationery at Rs. 35/- per annum ..	500
	*Carriage of office records and tents at Rs. 80/- per annum ..	1,600
	*Cost of service stamps at Rs. 120/- per annum ..	2,400

Period.	Particulars.	Amount.
		Rs.
	TEMPORARY ESTABLISHMENT.	
20 years ..	(*a*) 2 chowkidars for range at Rs. 16/- per mensem ..	7,680
	*(*b*) 1/3rd share of chowkidar for the divisional office at Rs. 16/- per mensem ..	1,280
	(*b*) One sweeper at Rs. 12/- per mensem ..	2,880
	(*c*) *Hot Weather Establishment.*	
	1 pankha coolie for range office at Rs. 90/- per annum ..	1,800
	*1/3rd share of 2 pankha coolies in divisional office at Rs. 60/- per annum ..	1,200
	*(*d*) Repairs to office furniture and tents at Rs. 50/- per annum ..	1,000
	*(*e*) Purchase of books and maps at Rs. 20/- per annum ..	400
	*(*f*) Miscellaneous at Rs. 50/- per annum ..	1,000
	Total Establishment ..	3,37,660
	Add—Conservancy and Works ..	9,38,349
	Total ..	12,76,009
	Add 10 per cent. contingencies ..	1,27,600
	Grand Total ..	14,03,609
	or say ..	14,04,000

* On the assumption that a plantation division comprises three 10,000 acres plantations.

2. FINANCIAL RESULTS.

A comparison of the revenue and expenditure figures will show that the formation cost of a 10,000 acre plantation after deducting therefrom the revenue figures will be only Rs. 50,000 or say Rs. 5/- per acre.

APPENDIX I.

Statement showing the sequence of temporary cultivation, stocking, irrigation and weeding, etc., on creation and upkeep of 20 acres plantation in 20 years' rotation.

Year.	New stocking in acres.	Stocked plantation in acres.	Temporary cultivation in acres.
1st	1	..	19
2nd	1	1	18
3rd	1	2	17
4th	1	3	16
5th	1	4	15
6th	1	5	14
7th	1	6	13
8th	1	7	12
9th	1	8	11
10th	1	9	10
11th	1	10	9
12th	1	11	8
13th	1	12	7
14th	1	13	6
15th	1	14	5
16th	1	15	4
17th	1	16	3
18th	1	17	2
19th	1	18	1
20th	1	19	0
Total	20	190	190

Serial No.	Nature of work.	20 YEARS' TOTAL AREA. Area for one acre of plantation.	Area for 500 acres coupe.
1	Creation ..	20	10,000
2	Upkeep ..	190	95,000
3	Temporary cultivation ..	190	95,000
4	Trenching ..	20	10,000
5	New stocking, *viz*:— Sowing and planting ..	20	10,000
6	Weeding ..	20	10,000
7	Irrigation by beldars ..	190+20	105,000
8	Kana stubbing from whole area ..	190+20	105,000
9	Silt clearing ..	190+20	105,000
10	Reopening of trenches 20×5	100	50,000
11	Thinnings:—		
	1st=15 acres × 500 ..		7,500
	2nd=9 acres × 500 ..		4,500
	3rd=5 acres × 500 ..		2,500
12	Restocking 20=2 × 500 ..		1,000
13	Miscellaneous:—		
	Clearing fire lines.		
	,, roads.		
	Repairs to buildings.		

NOTES ON REGENERATION TECHNIQUE IN THE CENTRAL PROVINCES.

BY TARA SINGH, I.F.S.

I.—ARTIFICIAL REGENERATION OF TEAK.

The problem of teak artificial regeneration in the Central Provinces and Berar where the average annual rainfall ranges from 25″ to 76″ is based upon three main obstacles which try the patience of new and old hands alike. Provided a suitable planting site is chosen, the practical difficulties are chiefly confined to—

(*a*) the very poor seed germination or its entire failure to germinate;

(*b*) the rearing of tiny and delicate seedlings in dry hot weather so as to secure strong and suitable plants in large numbers before the start of rains, and

(*c*) the safe transport and successful planting out of the seedlings or transplants when the rains have commenced (especially if the monsoon happens to be erratic).

Securing quick and abundant germination of teak seed.—To solve the first difficulty, it is absolutely essential to use *weathered seed*, as described by Tuggerse for Kanara (1) particularly when it is to be sown directly in the plantation area. The *unweathered seed* fails miserably (though sporadic seedlings may appear in the next year) thus causing considerable loss, besides dislocating the future planting programme.

Weathered seed may either be sown direct or the seedlings can easily be obtained from seed dumps placed on the actual planting area. Seed germinates quickly and very satisfactorily in such dumps when they are kept moist. The germinating seed and seedlings can be picked up gently from these dumps and immersed immediately in water. The vessel containing them should then be carried over the area while notching the germinating seed and seedlings with the help of fingers in the prepared soil. Spare seedlings from the dumps can be pricked in the nursery beds for future stump planting.

In the Provincial Sylvicultural Nursery, the *unweathered seed* has been tried for the last three years with satisfactory results by following the method used at the Forest Research Institute, Dehra Dun, which aims at the improvement of the seed bed rather than any preliminary treatment of teak seed. A sketch by Vahid Fig. 1, (2), shows the details of laying out such a seed bed and is self explanatory: it can be prepared easily in the nursery or on the plantation site.

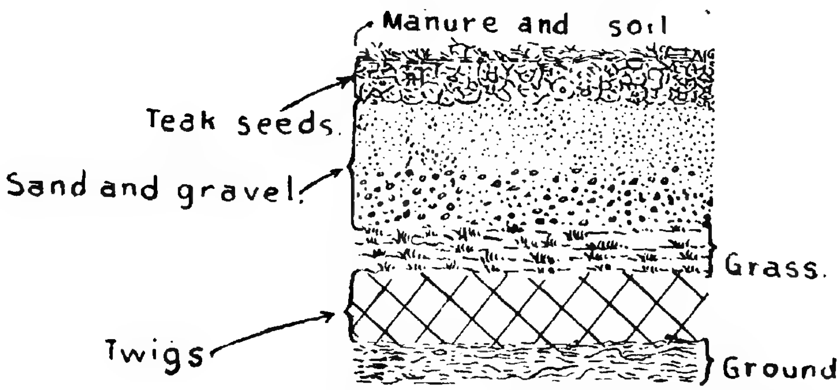


Fig 1. Profile of a specially laid out seed bed for accelerating the germination of *unweathered* teak seed.

Rearing and successful planting out of teak seedlings.— All the three difficulties have been combated with remarkable success in the Bilaspur (old North Raipur) Forest Division by Mr. L. H. Lokre, Divisional Forest Officer, 1930-31, (3) who evolved the *Dona* System. He raised three or four small but successful teak plantations by this method in the School Forest at Balaghat, and in 1931 introduced it very successfully in Tenduchua, Kothari and Deopur areas where the annual planting programme under the present working plan is particularly heavy. The efficiency of his method can be judged from the 1931 results. He raised 1,04,275 teak seedlings at Deopur and Kothari Nurseries from April sowings and had 63,510 strong *dona* transplants (of 4″ to 8″ high with 6 to 8 pairs of leaves) ready for planting out at the commencement of the monsoon; this enabled him to stock successfully, at 6′×6′ spacing, nearly 22 acres of the new area and to carry out replacements of large numbers of casualties in the old plantations with 25,146 and

12,765 *dona* transplants respectively, transferring the balance of plants to the nursery lines for future stump planting. The above programme included the creation of 12 half-acre plantations for the all-India seed origin investigation which were admirably formed in two sets, on gneiss and schist soils.

II.—THE " DONA " SYSTEM.

The procedure followed is divided into two stages, *i.e.*, in *nursery practice* and the *field operations* which are described below.

Nursery Work.—A suitable nursery site is selected near the planting area. A *manda* (temporary shed) of a size depending on the magnitude of work is then erected after the fashion of the ***Pan-Bareje*** (C. P.) or the ***Pan-Bhita*** (U. P.), a shed made for the cultivation of commercial betel leaves. Special attention is given to keep off the hot winds from the sides and hot sun from the top by placing seven foot high grass ***tattas*** (screens) on all sides, leaving a small entrance. A trellis work of split bamboos as the top covering affords ideal conditions to young seedlings. Gravel and sand are spread over a portion inside the enclosure so as to prevent the white-ant from destroying the *donas* (cups made of leaves generally of ***Butea frondosa, Butea superba*** or ***Bauhinia vahlii***) carrying the small teak seedlings. These leaf-cups are easily prepared anywhere in the country. The tiny seedlings, as soon as they have put on a second pair of leaves in about two-three weeks after germination, are picked out from seed beds with the help of a bamboo splint and are pricked into *donas* filled with good forest soil. The *donas* are perforated with small holes at the bottom to ensure drainage and are kept under the *manda* shade, watered twice daily and casualties replaced from time to time.

Field Work.—At the break of rains, the overhead trellis covering is removed to avoid damage by dripping and the *dona* plants, which are 4″—8″ high and carry five or more pairs of leaves are carried by the coolie on *kawars* (wooden or bamboo shoulder-rods used for carrying water, etc.), to the planting areas, each man transporting 30 to 40 *donas* per trip. The *dona* leaves are then removed and the teak plant growing

securely in the earth ball is placed in a 6″×9″ pit without the slightest disturbance to the root, and the pit is then filled up.

ADVANTAGES OF THE DONA SYSTEM.

i. The whole season of growth is made available for the plants.

ii. Casualties are confined to the *dona* stage and are not found to any great extent in the forest; replacements can thus be easily and successfully effected *in the nursery.*

iii. Plants get a much better start over grass and weeds and require comparatively little attention. The plantation work is thus more successful *from the very start.*

iv. The *dona* plants need little technical skill in packing, carrying and planting; ordinary labourers can attend to all this work successfully.

v. The planting out can be carried out at any time when the rains have set in: work can be taken up with confidence even in the glaring sunshine.

vi. Plants are raised in the open season when the work can effectively be supervised by the higher staff. This is also the slack season for the cultivator who provides prompt and cheap labour.

vii. The cost of creation and subsequent upkeep is low and is capable of further reduction.

viii. After the completion of annual planting and refilling of casualties, the excess of *dona* plants can with advantage be transferred to the nursery lines at the close of the working season; they will supply year-old stump cuttings for filling up blanks in the following year, thus ensuring the complete stocking of the area in the shortest possible time.

I am indebted to Mr. L. H. Lokre, the former Divisional Forest Officer, Dy. Ranger Tara Singh, the Plantation Officer, and particularly to Mr. L. Rai, the present Divisional Forest Officer of Bilaspur (old North Raipur) Division for supplying information on teak planting operations carried out during the year 1931.

REFERENCES.

(1) M. S. Tuggerse ; " Some methods for securing the germination of teak seed " Indian Forester, April 1925.

(2) Annual Report on Working Plans and Research in the Central Provinces and Berar for the year ending 31st March 1929.

(3) Annual Report of Nursery Work, Bilaspur (old North Raipur), for the year ending 31st March 1932.

III.—FIRING OF THE FOREST AREA TO BE NATURALLY REGENERATED WITH TEAK.

An extract detailing " *Burning on areas to be planted with teak* " appeared in the *Indian Forester* of May 1932 and readers may find the following account of some further interest : it deals mainly with the effects of burning on the experimental areas in Betul Division where the natural regeneration of teak and some of its associates has been under investigation for the last two seasons.

Experimental Plots Nos. 9 and 10 were laid out on the Baretha Ghat in April 1931 primarily to study the growth and development of the natural reproduction in teak (mixed) forest and incidentally to observe the effect of firing, both in inducing seedling recruitment and on coppice regeneration. The entire overwood was removed and each of the plots was further divided into two sub-plots, one sub-plot to be burnt and the other half to be fire protected. Sound advance growth was left standing except in sub-plot A in which it was clear felled before burning ; this brushwood lot was burnt during May 1931.

Seedling Regeneration.—The *burnt* sub-plot showed numerous teak, *saj* (*Terminalia tomentosa*) and *tinsa* (*Ougenia*) seedlings all over the area by the end of July 1931 : *haldu* (*Adina cordifolia*) seedlings had also appeared on the ashes though there was no parent tree on the area or in the immediate neighbourhood. By the middle of August the seedlings had grown 2″ to 4″ high and looked vigorous. A count

of the recruitment and survivals was made along strips 6′ wide and in 6′ squares in May 1932 and the results are as under :—

Sub-plot.	Tinsa.	Saj.	Teak.	Total.	Tinsa and Teak.
Expl. Plot No. 9 .. A (clear-felled & *burnt*)	11 (23%)	9 (19%)	12 (26%)	32 (68%)	49%
B (Advance growth retained and *unburnt*)	2 (4%)	15 (53%)	0 (0%)	17 (37%)	4%

It is hence apparent that the clear-felled and *burnt* area is carrying uniformly nearly 50 per cent. fresh recruitment of really first class species like teak and *tinsa,* whereas the *unburnt* sub-plot with advance growth shows only a 4 per cent. recruitment of such valuable species. Many teak seedlings in sub-plot A seen during July-August 1931 had died back during the last hot season thus reducing the survival percentage. The height growth of survivals ranged from 3″ to 6″ in one season.

Firing after clear-felling seems to have definitely helped the natural regeneration from seed of all the species mentioned above. Also, fire had consumed a good deal of debris and the damage to the coppice reproduction by suppression was found to be negligible. It may further be remarked that another sub-plot which was *clear-felled but kept unburnt* carried hardly any teak recruitment when examined in May last. An examination of the reproduction of teak coppice and its subsequent development in Plots 9 and 10 was made in May 1932 ; they do not yet show any very significant difference after a season's growth.

Conclusions.—It is too early to pronounce any definite opinion when the experimental evidence is so scanty, but the above observations on seedling recruitment tend to show that burning on the regeneration area has apparently increased the chances of teak seed germinating easily and early, possibly by effecting a physical change in the outer bony coat of the hard nut, which is ordinarily in permeable to water under the Central Provinces forest conditions for a considerably long time.

Experiments of running surface fires (which are necessarily of moderate intensity) over areas devoid of natural regeneration have been instituted in the teak high forests of Betul, South Chanda and North Chanda Divisions and results are awaited with interest. The burning operations in Allapilli and Pedigundum Ranges (South Chanda), prescribed under the new working plan, are reported to have resulted in vigorous response and areas which contained no seedlings are said to be carrying teak regeneration. Many long suppressed seedlings were killed back by fire, but the subsequent reproduction is described to be very promising.

The Central Provinces teak fruit—a comparatively small and hard bony nut—appears to be particularly difficult to germinate even under ordinary nursery conditions. The fruit invariably needs *weathering* to get any success in artificial operations. In the forest the seed lies dormant for one or more years and the outer coat is only gradually acted upon by the weather, the white ant and other biotic agencies. If the disappearance of the hard covering coincides with the monsoon all is well, otherwise the seed is lost. It is probably this mechanical alteration of the hard covering of teak seed as well as perhaps the partial splitting up of the nut which is brought about by the burning of the forest area which leads to quick germination of seed during the following rains.

Examination of teak fruit from various origins has shown a remarkable difference in the size and nature of the outer covering of the C. P. nut; it tends to confirm the belief that the exceptional obstinacy of the C. P. teak seed in germinating is to a great extent due to the exceedingly hard and compact fruit which is devoid of any thick felty covering such as found in the seed samples from Burma, Madras, Mysore and Bombay, received in connection with the all-India seed origin investigation.

IV.—Boga and Arhar as Cover-Crops for Plantations.

A note headed "*Substitute for Boga as a sal cover-crop*" in the September issue of the *Indian Forester* suggested growing *arhar* (*Cajanus indicus*) in place of *boga*, " more specially where danger to

young *sal* from frost is indicated." A reference to Duthie and Fuller's *Field and Garden Crops* (Part II—1883) will be of interest; it reads as follows under the heading of "Injuries":—

"Frost is the principle enemy with which *arhar* has to contend. A single cold night often utterly ruins the crops of a whole district, and in the following morning the cultivators may be seen sadly cutting down the withered plants as fodder for their cattle. Its liability to damage is however greatly dependent on the strength of the plants, and hence the crop grown on manured land near the village site will often remain green and flourishing after a frost which has withered up those on outlying fields. The practice of irrigating as a safeguard against frost has been already noticed." The behaviour of *boga* in this connection is, however, not generally known.

It may here be useful to mention that there are several varieties of *Cajanus indicus* (Spreng) which differ "more or less in the colour and size of the seeds." The same two authors detail the following account. "The two varieties alluded to under the names of *C. flavus* and *C. bicolor* are known respectively as *thur* and *arhar*; the latter is the one most commonly cultivated in these Provinces (now the U. P.). It is easily distinguished by having its standard veined with purple instead of being plain yellow as in *thur*. *Thur* takes the place of *arhar* over a great part of the Central Provinces, and is distinguished there by its much shorter habit of growth, and by its flowering at least 3 months earlier than *arhar*."

Enquiries made from the Economic Botanist to Government of the Central Provinces show that *thur* (*C. flavus*) is susceptible to wilt disease and that frost has an adverse affect on the setting of the seeds. Also, that if it is grown to form a perennial crop, as in the case of forest cover, it will certainly affect the yield and seed formation adversely and the second year will not be normal; the revenue from seed will hence be of little consequence after the first year.

It is not yet definitely clear whether *thur* and *arhar* retain their foliage in late winter and the following hot summer when the leaves are essentially needed to protect the forest seedlings from frost and desiccation, respectively. If the plants are deciduous, they must fail in

their utility as *nurse crops* for the young plantations during the trying periods and hence they should not replace *boga* ; otherwise, both the varieties are well worth a trial.

Cajanus indicus is agriculturally important as it is largely grown mixed with *juar*, *bajra* and cotton, etc., over a wide area. Its major economic importance lies in the utility of its seed for the daily pot of the cultivator. Also, " the leaves form an excellent fodder. The stalks are valuable for roofing, basket-making, and above all, for making the tabular wicker work fascines (*bira* or *ajar*) which are used to line earthern wells in order to prevent the earth from falling in." It is therefore worth while to try the species (preferably alternately with the *boga* lines) and obtain practical results before dropping the *boga*.

References.—The following publications may be consulted with advantage :—

(1) J. F. Duthie and J. B. Fuller.
Field and Garden Crops of the North Western Provinces and Oudh, Part II (Roorkee—1883).

(2) D. N. Mahta.
Memoir on *Cajanus indicus* (Government of India, Central Publication Branch, Calcutta).

REVIEWS.

REPORT UPON THE COMPARISON OF INDIAN-GROWN HONDURAS MAHOGANY WITH NATIVE TIMBER OF BRITISH HONDURAS.

(FOREST PRODUCTS RESEARCH LABORATORY, PRINCES RISBOROUGH).

This report is the result of an investigation started by the Timber Advisor of the High Commissioner for India, who was of opinion that India would be justified in extending plantations of *Swietenia macrophylla*, if the timber of this species was found equal or approximately equal to native grown Honduras mahogany.

The strength tests showed that the Indian grown timber was slightly heavier, about 10 per cent. weaker in static bending, and slightly weaker in compression parallel to grain, than the timber of Central America, but at the same time it was harder and had more resistance to splitting. The "commercial" tests carried out by selected cabinet makers, H. M. Office of Works, and the Southern Railway, were generally favourable, and showed that the Indian-grown wood compared reasonably well in general working qualities with the Honduras wood. This fact was already well known in India, where one or two of the largest cabinet making firms in the country reported some years ago that they preferred the Indian-grown wood to the imported article, and that they used it for fronts and panelling in preference to the imported wood. Both Madras and Bengal-grown timber have been used on several occasions at the Forest Research Institute at Dehra Dun, and several pieces of furniture made from mahogany from both districts have been under observation there during the past six years. The observations recorded endorse the general opinions of cabinet makers as expressed in this publication, namely that the Indian-grown mahoganies are in every way equal to the nature-grown timber. The chief drawback in the past to a more extensive cultivation of *Swietenia macrophylla* in Madras has been the damage that this species has suffered from a bud shoot borer, but it is mentioned in the Report that this difficulty has now been overcome, and that there should be no extensive trouble in raising *Swietenia macrophylla* in mixed plantations where conditions are suitable.

The publication is an interesting and useful addition to forest literature, and the only criticism one can offer is that it might have been made more useful still if the authorities at Princes Risborough had consulted the Forest Research Institute at Dehra Dun, where several tests on Indian-grown mahoganies have been carried out, including an investigation on its veneering qualities, a subject which is not mentioned in the Report under review. The general conclusion arrived at in the Report that, given favourable sylvicultural and extraction conditions, *Swietenia macrophylla* should be well worth growing on a more extensive scale, seems fully justified.

BETTER SEASONING METHODS.

That closer attention is being paid to the more accurate seasoning of timber is clearly shown by two recent pamphlets, one issued by the *Forest Products Research Laboratory at Princes Risborough* (" The Determination of the Moisture Content of Timber," price one shilling), and the other by the Australian Council for Scientific and Industrial Research (" Sample Boards," Trade Circular No. 7). Both of these emphasise the need for some simple but scientific method of *measuring* the process of seasoning, instead of depending upon the time-honoured but vague methods of judging by its feel or its weight in the hand whether a piece of wood is fully seasoned or not. Such great variation is brought about during the process of seasoning in the stack by changes in weather, temperature, ventilation, and method of stacking, that the builder's specification that his wood should be " well seasoned " is not enough, particularly for carpentry work in buildings with central heating, or in climates such as our Indian one with great extremes in humidity.

Both these pamphlets give detailed instructions on the cutting and preparation of sample boards, which are to be weighed at intervals to check the progress of seasoning ; the type of simple oven and scales to be used in placing of these sample boards in the stacks so that they get the same aeration as the rest of the wood ; the handling of very resinous wood ; and detailed examples of how the percentage moisture figures are arrived at. To assist in this last step, the Australian pamphlet includes a most useful chart for use as a ready reckoner. It consists of three parallel scales, each marked off into numbered divisions to show :—(*i*) initial weight of sample board ; (*ii*) oven-dry weight of sample board ; and (*iii*) percentage moisture content calculated on oven-dry weight of sample. If any two of these are known, the third can be found at once from the chart by running a straight line across through the two known figures to cut the third scale.

R. M. G.

THE IDENTIFICATION OF IMPORTANT INDIAN SLEEPER WOODS.

BY K. A. CHOWDHURY, WOOD TECHNOLOGIST, FOREST RESEARCH INSTITUTE, DEHRA DUN (FOREST BULLETIN NO. 77 OF 1932).

This Forest Bulletin is of special interest as it is the first of a series of similar publications to be issued by the Forest Research Institute for all the Provinces of India. Future keys will, however, be based on localities rather than uses, but as Railway sleepers have always formed a very large proportion of the total production of timber from Indian forests, it was considered that a key for the identification of sleeper woods had first claim.

The first portion of the Bulletin gives a short but clear description of the gross features of wood, followed by a few remarks on other features such as colour, lustre, odour and weight, which are important characteristics in the identification of timbers. This is followed by a very clear description as to how the novice should proceed to identify sleeper woods by the use of the key. The key itself is well worked out and simple to use, and with a little practice it should not prove difficult for anyone acquainted with the structure of wood to identify any sleeper wood in the course of a few minutes.

A great many of the 59 species mentioned in the key are also used for purposes other than sleepers, so the use of the key is not confined to the sleeper trade only, and there is little doubt that it will prove useful to anyone handling Indian woods for other purposes.

A list of trade names and other common names follows the key, and a complete set of photo-micrographs of all the woods mentioned in the key increases the usefulness of the publication. These photographs are taken at a x10 magnification, or in other words, are representative or what one can see on the cross section of the woods with a pocket lens. The combined use of these photographs and the key itself should make identification a comparatively simple matter even to those not well acquainted with wood structure.

Finally there is a map of India showing the sleeper woods derived from different areas. This again is a useful addition, as it will enable the novice to get an idea of the woods he is likely to encounter in his own district.

The whole publication is well turned out and except for a printer's error in the name of one of the species, appears to be flawless, which reflects great credit on the author. Some of the photographs might have been reproduced with greater clearness, but this is the fault of the Press, as the writer has seen the originals, and Mr. Chowdhury cannot be blamed for any fault in this direction. Altogether a very refreshing little publication which will no doubt be given a prominent place in most Forest Officers' bookshelves.

[It has subsequently been found that the Printers have got certain plates mixed in some of the copies issued direct by the Government Press.—ED.]

THE PROBLEM OF THE PURE TEAK PLANTATION.

BY H. G. CHAMPION, I.F.S.—FOR. BULL. (SYLVICULTURE SERIES) NO. 78.

The charges commonly made against the practice of growing teak in pure stands are carefully analysed, and it must be recognised as proved that teak generally develops badly unless when grown in the mixed stands which characterise its natural condition. Accurate comparative data are still lacking but the conclusions are that teak falls off in health and growth, fluted boles are more prevalent and the damage by the beehole borer and other pests is worse in pure plantations. The other charges such as the prevalence of epicormic branches and of defoliation, Mr. Champion prefers to leave under the non-committal Scots law verdict of "not proven," while the increase in erosion under pure stands is put down more to the effect of ground fires than to the actual constitution of the crop.

The danger of drawing conclusions from European experience is emphasised, and specific remedies in dealing with these various defects are given, most of which hinge upon the introduction and encouragement of accessory species of trees or bamboos, and a more efficient soil cover. The choice of a really satisfactory companion tree is still an open question. No single species has been accepted as forming a satisfactory mixture in the upper canopy though the five page list of those which have actually been tried shows how widely

the provincial sylviculturists' nets have been cast in their search for good companions. Planting in intimate mixture with a slow-growing species has been extensively tried but tends to develop bad stem form. Mixing by groups shows promise of better results but we have not yet got sufficient data and much research and experimental work remains to be done before this and the allied problems of cover crops and the retention of natural regrowth in felling areas can be solved.

Mr. Champion indicates that much of the alarm over the " pure teak problem " is due to mistakes in past management, such as the Nilambur practice of consistently clearing away all undergrowth, and the commoner one of destroying accessory species which are competing with teak in the upper canopy. He also emphasises the need for early and frequent thinnings which help materially towards developing the best natural underwood and soil cover.

R. M. G.

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IMMATURE STAGES OF INDIAN COLEOPTERA (PLATYPODIDAE) No. 11.

By J. C. M. Gardner, I.F.S.,—Ind. For. Rec. (Entomology Series), Vol. XVII, Part III.

This forms another instalment of the unobstrusive but useful systematic work which the Entomologist's Branch is doing at Dehra Dun. The present slim volume with two plates of line drawings deals with the genera *Diapus*, *Crossotarsus* and *Platypus*.

EXTRACTS.

UTILISATION OF SAWDUST.

Something like 7,000 carloads of wood waste reported annually in New York State, now a sheer waste, may be turned to good and profitable account in future if the recommendations following a survey of non-utilised wood in the State are followed. An exhaustive report of the survey has recently been released. Some of the points and the recommendations contained in it are similar to those referred to in the special article in our columns a few weeks ago by Mr. Axel H. Oxholm, who described the work of the National Committee on Wood Utilisation in the U. S., of which he is director. This new report, dealing specially with non-utilised wood in industrial plants and logging operations in New York State, gives detailed information in regard to the character, kind and availability of 6,800 carloads of wood waste which may be annually offered for sale there. The utilisation of this material will not only relieve the drain on the forests in New York State, but will also create new industries and increased employment.

One section of the report deals with the occurrence of non-utilised wood. The following table shows the approximate percentages of these different types of waste throughout the country as a whole:

WOOD WASTE DISTRIBUTION.

	Per Cent.
Woods losses	24
Decay (during storage and in service)	20
Mill losses	12
Seasoning	4
Re-manufacture	2
Unclassified	4
Total ..	66

The above table indicates that about two-thirds of the annual drain on the U. S. forests is wasted. Although much of this waste occurs in the woods, a considerable percentage of it is accounted for by saw mill manufacture. Then follow two tables showing the relative efficiency of European and American saw mill methods. In European countries a mill utilising less than two-thirds of the log cannot operate at a profit. These tables indicate that the American saw mill utilises only about 46 per cent. of the log, whereas the Swedish saw mill utilises 69 per cent. of its raw material.

Waste involved in Converting a Log into Lumber in the United States.

	Per Cent.
Bark	13·0
Edgings and trimmings	8·7
Slabs	8·7
Sawdust	13·5
Miscellaneous	3·5
Seasoning	7·0
Seasoned rough lumber	45·6
	100·0

Waste involved in Converting a Log into Lumber in Sweden.

	Per Cent.
Sawdust	8·0
Slabs, bark, refuse	12·0
Edgings and trimmings	6·0
Shrinkage and seasoning waste	5·0
Seasoned rough lumber	69·0
	100·0

Utilisation of sawdust forms an interesting section of the survey. This, it is stated, is a problem which has long engaged the attention of the lumbering and wood working industries, and has received more study than the utilisation of any other item of mill waste. A number of industries are now using sawdust in their manufacturing processes. The requirements of many of these industries, however, are very exacting. For example, sawdust used in the manufacture of wood flour and in the leather industry must be separated by species and stored until a carload has accumulated. Many industries have strict specifications as to colour, bulk analysis, screen test, chemical reaction, dryness, the presence of bark, and excess resin and other foreign materials. As with the utilisation of all types of surplus wood, the industrial use of sawdust is limited largely by the cost of transportation to consuming centres.

Wood Flour Manufacture.

It is estimated that 28,000 tons of wood flour, valued at 75,000 dollars, were manufactured in the United States in 1929. In addition, slightly more than 9,000 tons were imported. Both sawdust and shavings are utilised in the production of this commodity—in fact, 60 per cent. of the wood flour produced is manufactured from these items. It should be remembered that the technical wood flour used in the manufacture of all phenol resin products, such as bakelite, redmanol, condensite, durez, and others, must be of the finest grade, and free from such impurities as excessive resin, gums, bark, and dirt, which are permissible in some of the non-technical wood flours used for other purposes. At present only shavings and wood of white pine are used in the manufacture of technical wood flour. About 75 per cent. of all wood flour produced is manufactured from that species. The remaining 25 per cent. is chiefly made from poplar, spruce, hemlock, maple, and birch, although ash, basswood, fir, and other light-coloured species might be used.

Of the U. S. domestic wood flour, 67 per cent. is used in the manufacture of linoleum, 15 per cent. in the manufacture of plastics, and 14 per cent. in the manufacture of explosive. The remaining 4 per cent. is used in the manufacture of dolls, wallpaper, and a number of miscellaneous products.

The latest authentic information shows that there are seven important wood flour producing mills in the United States, and four of these are located in New York State. These plants should be in a position to utilise quantities of non-utilised wood provided that sources of supply are readily available which will meet the consumers' demands with regard to quality and species.

A great deal of experimental work has been done on the process of manufacturing sawdust and shavings into fuel briquettes. In Europe the wood briquette has a definite place in economic competition with other fuels, but, so far, it has had little commercial success in the United States. The reason for this may be traced to the cheapness of other types of fuel, and to the cost of manufacturing and transporting briquettes.

Many serviceable types of briquettes have been evolved. Waste material has been briquetted in its original state, and in various stages of carbonisation. It has also been mixed with coal screenings and other material. Numerous cohesive agents, such as tar, resin, waste liquor, wire, and rope have been used. An improved briquetting machine makes a briquette of sawdust, or any other waste material, by application of pressure sufficiently high to destroy the natural elasticity of the wood. Briquettes of this type hold together without a binder, and are not readily broken in handling.

A partial list of additional uses of sawdust is given in the report as follows:

An absorbent.—Butchers' shops, markets, packing houses, currying animals, and kennel bedding.

Cleaning (drying and polishing).—Aluminum utensils, metal products, tubing, and wire novelties.

Composition products.—Artificial wood, cast products, clay products, composition flooring, concrete roof tiles and slabs, concrete products, floors (for sound deadening), gypsum compositions, moulded articles, plaster boards, stucco and plasters.

Fuel.—At points of production (saw mills, factories, etc.), briquettes, domestic purposes, gas products, steamboat use.

Heat insulation.—Cars, ice houses, and homes.

Miscellaneous.—Canning extracts, carborundum and calcium carbide, chemical purposes, cleaning and dressing furs, colouring clay pipes, distillation, dye production, ethyl alcohol, extraction, fertiliser, fireworks, floor-sweeping compounds, gas purification, hand soaps, hardening and annealing of metals, leather industry, lettering and decorating, lime burning, meat smoking, medicinal uses, nursery practice, oil-fire extinguisher, oxalic acid, protection of freshly poured concrete, roofing paper, railroad signal rockets, wall paper, waterproofing mixtures, wood flour, wood meal fodders.

Packing.—Grapes and fruit, ice, and miscellaneous products—

(*Timber Trade Journal*, 17th September 1930.)

SOIL PHYSICS IN RELATION TO METEOROLOGY.

Dr. B. A. Keen, of the Rothamsted Experimental Station, discussed "Soil Physics in Relation to Meteorology" at the C. J. Symonds Memorial Lecture for 1932 of the Royal Meteorological Society (*Q. J. Roy. Mte. Soc.*, July). This new branch of physics has made it necessary to discard a number of generally accepted explanations of agricultural and horticultural matters connected with the soil. Russian work on

soil classification has, for example, led to the recognition of certain soil groups as a basis for a survey of the soils of the whole world, and it is found that the type of soil formed in any place is dependent not so much upon the geology of the neighbourhood as upon certain meteorological factors, especially temperature and rainfall. Analysis of vertical sections of the soil, or soil ' profiles ' shows unmistakably that the amount of percolation of rain water decides whether certain alkaline salts derived from the weathering of rocks shall be washed downwards or not, and it is because of their effect upon percolation that these two meteorological factors are so important. As an offset to this case of underestimation of meteorological influence, Dr. Keen cites a case of overestimation, the subject being the aeration of the soil. The point that had to be explained was how it comes about that the composition of the soil atmosphere is so nearly the same as that of ordinary air, in spite of the fact that most biological activity in the soil tends to absorb oxygen and evolve carbon dioxide. A critical examination of the different processes leading to gaseous exchange between the soil and the atmosphere points to ordinary gaseous diffusion as the principal agent of exchange, meteorological processes being too slow. The rate of diffusion, moreover, is dependent upon total pore space rather than upon the size of individual pores, which would appear to dispose of the idea that ' heavy ' soils—those with the smallest particles—are necessarily the most badly aerated. Another important point made in the lecture is that water is not conveyed to the surface of the ground by capillary action from nearly such great depths as had at one time been supposed, from which it follows that the good effect of a surface mulch of loose soil or other material is often unconnected with the reduction of evaporation from the surface.—(*Nature*, 24th September 1932).

"WOOD, WOOD, WOOD" ALL THE TIME.

By R. R. Rivers.

It is more than likely that among those of us who have not gone to the "big huddle" (as it would be called in an "educational" film from way-back) at Ottawa, some will spend their holidays in a perfectly normal way in our own country. This fact prompts an appeal to hotel keepers, friends, landladies, relations, and such-like odd fry with whom we men of wood (as distinct from wooden men) may be compelled to "dig," or hang out. I would solemnly ask them to remember that we come to them for a change and rest, and, for the time being, wood plays no part in our lives. We do not wish to be consulted about the price of firewood, or to discuss the question of slavery in the Russian or English timber trade. As a matter of fact, most of us will spend this year's holiday wondering what we are going to use for money on our return!

My own recent experience may act as a timely warning to all timber men either to travel incognito, or to stipulate upon arrival that the subject of timber is barred, especially if they are going to have a supposedly cheap time with relations, as I did. They, of course, knew that I came from the wood, and I am not going to say I am not proud of being in the old trade, but the next time I travel I am firmly resolved to spread it about that I am in the doll's eye trade, and that I have never heard of oak, teak, walnut, t. and g. flooring, etc.

Immediately upon arrival I could feel the halo thrown round me by the younger members of the household, and soon realised that my holiday was going to be one long drawn-out martyrdom. They looked upon me as having a profound knowledge of all woods, both living and dead, and I was regarded as a sort of bureau from which free advice could be obtained on all matters where timber enters.

Expressing an intention of strolling to the beach, I was instantly foiled by a cousin, who persuaded me to accompany her to the furniture shop in order to prevent the possibility of her being "palmed off" with a deal book-case for a mahogany one. The next day I was introduced to a "friend" who was building a garage. He wanted to know the kind of wood he should use, and where he could obtain it below cost price. Later, a nephew, still at school, gave me the size of an imaginary floor, and asked if I could tell him the exact number of cubic feet of timber required to cover a floor thirteen-sixteenths as big as the given dimensions.

Another friend, who appeared to be studying for the Civil Service," would be glad, old man, " if I would tell him the tonnage of British woods imported to this country in the year 1845! On the Sunday afternoon, in a rash spirit of charity, I asked my aunt to accompany me on a walk. We hadn't gone far before she stopped suddenly and asked, " What is the name of *that* tree ?" At a gathering the same evening I was called upon to identify the wood of a snuff-box which had been in the family for generations, and asked whether I thought the sniffing of "pinewood" was good for curing colds! Do you think I was very wicked to let my conscience stretch considerably in answering the last question ?

Anyhow, at that moment I struck the brilliant idea of giving Empire wood a leg up, so I said that people who had furniture constructed of *chuglam* or *gumhar* never had any *complaints*. This led to numerous other inquiries about the healing propensities of wood, and although it was nice to be thus "lionised," I began to wonder if my holiday would ever start. It never did. Wood, wood, wood, all the time!

(*Timber Trades Journal, 20th August* 1932).